Sept. 3, 1963 O. S. TUTTLE 3,102,615

PANEL ASSEMBLY

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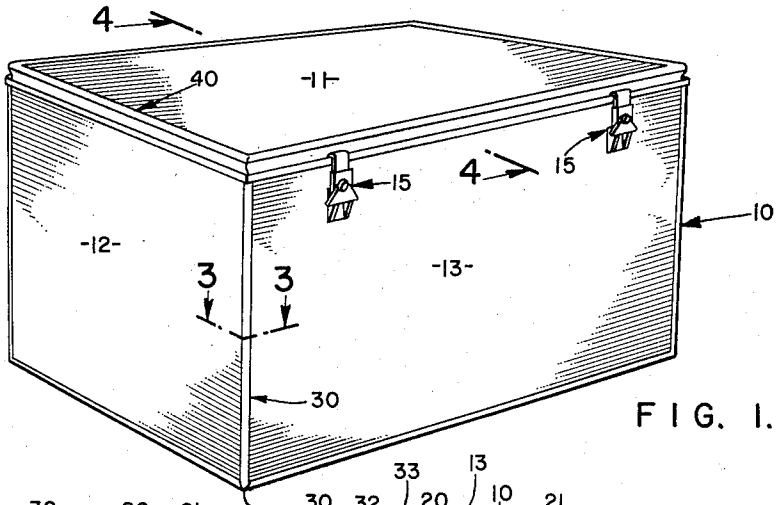


FIG. 1.

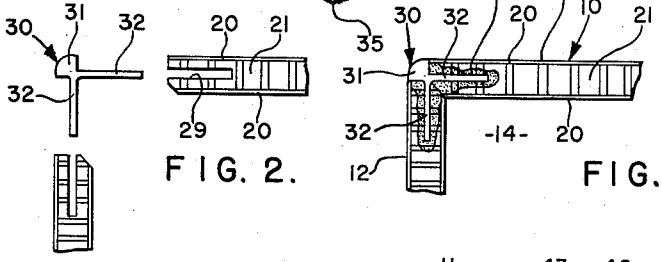


FIG. 2. FIG. 3.

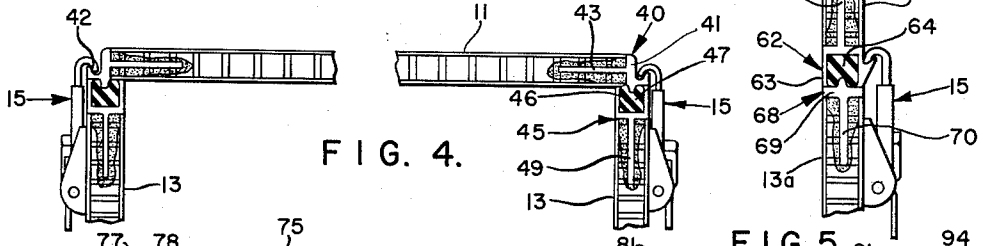


FIG. 4. FIG. 5.

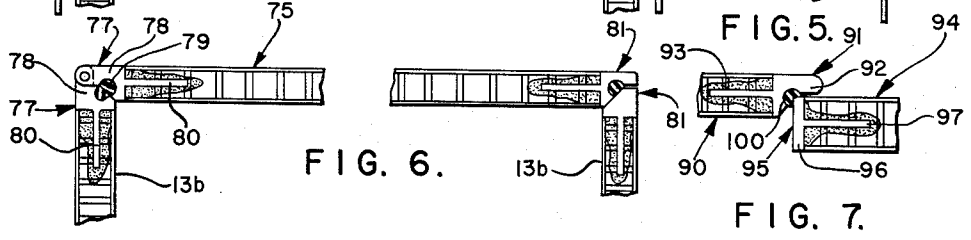


FIG. 6. FIG. 7.

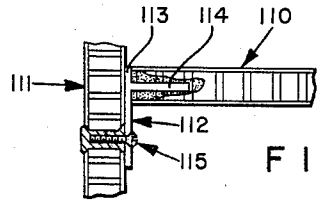


FIG. 8.

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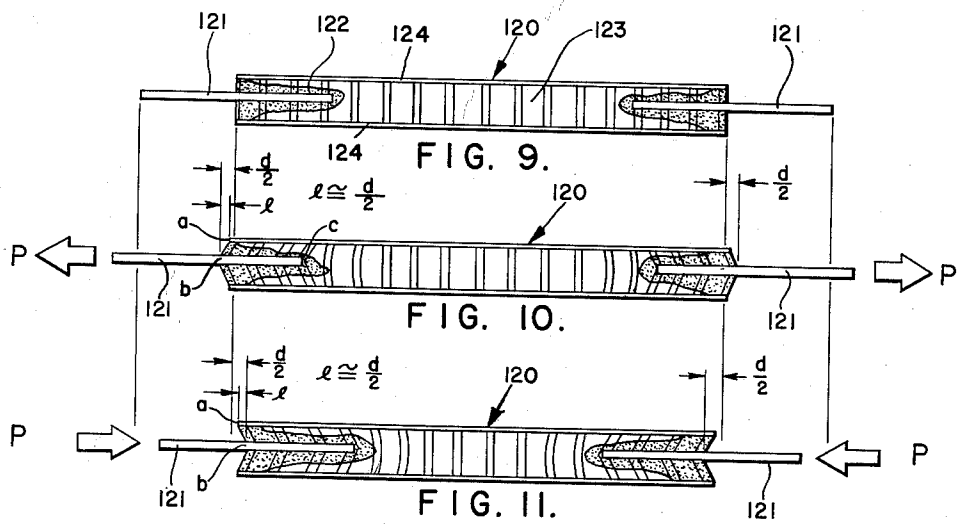


FIG. 9.

FIG. 10.

FIG. 11.

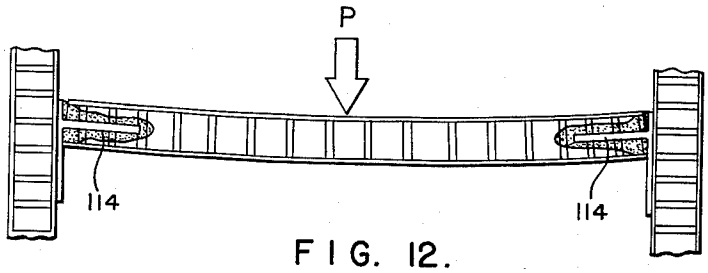


FIG. 12.

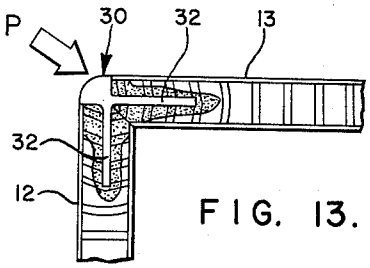


FIG. 13.

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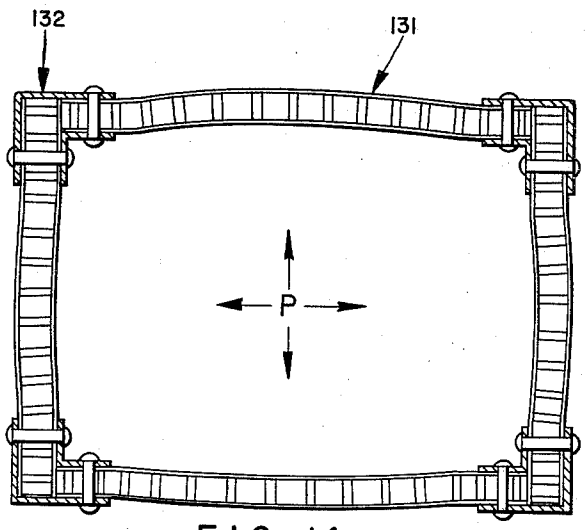


FIG. 14.

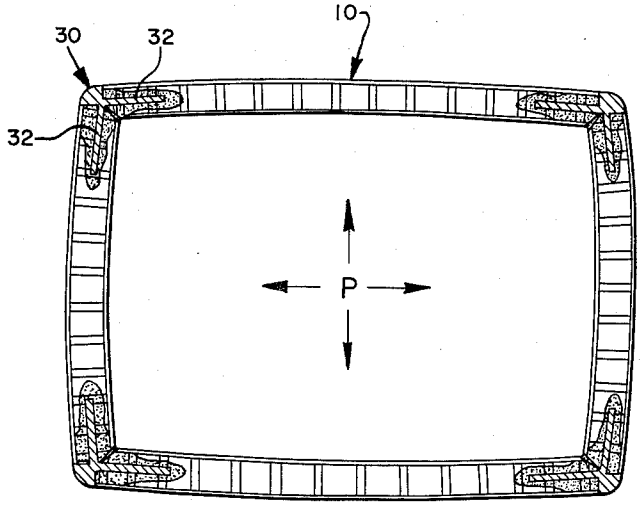


FIG. 15.

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PANEL ASSEMBLY

Orvil S. Tuttle, Pacific Palisades, Calif., assignor, by direct and mesne assignments, of one-half to Pelham Corporation, Inglewood, Calif., a corporation of California, and one-half to Monogram Precision Industries, Inc., Culver City, Calif., a corporation of California

Filed June 17, 1960, Ser. No. 36,848
9 Claims. (Cl. 189—36)

This invention relates to panel assemblies and has particular reference to an improved apparatus for joining intersecting panels such as the corner construction of a box structure, and/or a hinged cover intersection and/or the joining of a partition and/or the joining of a shelf panel to a panel construction.

The present invention is an improvement over the construction described and claimed in my copending application Serial No. 736,077, filed May 19, 1958 entitled "Panel Construction," now U.S. Patent 2,986,245.

A primary object of the present invention is to provide a novel and improved panel assembly whereby tension and/or compression stresses can be loaded effectively through the joint into the panel structure.

A further object of the present invention is to provide a novel and improved panel assembly embodying a joining construction more flexible than the panel permitting loads to be absorbed into the full structure rather than concentrating in the joint.

A further object of the present invention is to provide a novel and improved panel assembly embodying watertight joints such as required in a pressure tight container.

Still another object of the present invention is to provide a novel and improved panel assembly such as a container or box construction adapted to the economical production of small or very large structures in limited production runs as well as in continuous production runs.

Other objects and advantages of the present invention it is believed will be readily apparent from the following detailed description of a preferred embodiment thereof when read in connection with the accompanying drawings.

In the drawings:

FIGURE 1 is a perspective view of a box embodying the present invention.

FIGURE 2 is an exploded view of the corner construction in accordance with the present invention.

FIGURE 3 is a sectional view taken substantially on the line 3—3 of FIGURE 1.

FIGURE 4 is a sectional view taken substantially on the line 4—4 of FIGURE 1.

FIGURES 5–7 are sectional views similar to FIGURE 4, but illustrating modified forms of the invention.

FIGURE 8 is a fragmentary sectional view illustrating a further modified form of the invention.

FIGURES 9–15 are diagrammatic sectional views illustrating the engineering principles embodied in the present invention.

Referring now to the drawings, the invention is illustrated as embodied in a container or box 10 having a hinged top or cover 11, end walls 12, side walls 13 and a bottom 14. The bottom 14 is joined to the end and side walls 12 and 13, which lie in mutually perpendicular planes, intersecting the bottom 14 at right angles. Suitable latches 15 are provided for maintaining the top in the closed position. The particular shape of the box and the hardware illustrated form no part of this invention and are merely illustrative.

The top, bottom and walls of the box 10 may be formed of any desired type of sandwich panel such as those having metal or plastic faces supported with honeycomb cores, foamed plastic or a plywood core. In the specific embodiment illustrated, the box is made from

panels having metal face sheets 20 and a honeycomb core 21. The faces 20 carry the load in the plane of the panels, while the core 21 carries shear stresses and resists compression loads normal to the plane of the panel. In addition, the core will absorb in shear shock loads such as occur when the box is dropped on an edge or corner and transfer these loads uniformly into the panel facings as illustrated in FIGURES 9–13 and described hereinafter.

The intersecting edges of the panels are provided with recesses or slots 29 as shown in FIGURE 2 and joined as shown in FIGURE 3 by means of a T- or Y- or L-shaped frame element 30 preferably a metal extrusion, comprising a body member 31 carrying a pair of legs or flanges 32 which intersect to form a right-angled channel. The frame elements 30 extend for the entire lengths of the intersections between the respective panels, the legs 32 being received in the slots 29, which are initially filled with adhesive material 33, the frame elements being adhered or bonded thereby to the cores in water-tight relation therewith. At the lowermost corners 35, the ends of the frame elements are each bevelled at a 45 degree angle so as to abut each other in right-angled joints.

A frame element 40 extends around the periphery of the top 11, the element 40 comprising a body member 41 having a suitable groove 42 for the latches 15, and a flange 43 extending within a slot 44 and adhesively bonded to the core in the same manner as described above. The upper edges of the edge and side walls are protected and sealed by a frame element 45 having a channel portion 46 carrying a gasket 47, and having a flange 49 extending into a slot in the core in the same manner as the flange 43.

The modified form of the invention illustrated in FIGURE 5 is similar to that of FIGURES 1–4, but here the top of the container is provided with walls 61 extending parallel to the side walls 13*a*. The walls 61 are edged with a frame element 62 comprising a channel body member 63 carrying a gasket 64, and having a flange 65 extending into a slot in the core as described above. Similarly, the walls 13*a* are edged with a frame element 68 having a body member 69 and a flange 70 depending therefrom into a slot in the core.

FIGURE 6 illustrates a modified form of top structure wherein the cover 75 is connected to one side wall 13*b* by means of a piano hinge formed by a pair of pivotally connected frame elements 77, each having body members 78 provided with gaskets 79, and flanges 80 extending into slots in the respective cores. The three unhinged edges of the cover and containers walls are edged with frame elements 81 identical with the elements 77 but not including the pivotal connection.

The modification of FIGURE 7 comprises a container wherein the cover comprises a door member 90 the edges of which are protected by a frame element 91 comprising a body member 92 and a flange 93 bonded into a slot in the core of the door. The top wall 94 is edged with a frame element 95 having a body member 96 and a flange 97 bonded into a slot in the wall core, a gasket 100 being provided for sealing purposes.

FIGURE 8 illustrates a shelf or partition structure wherein a partition member 110 is connected to the wall 111 by means of a frame element 112 extending along the edges of the partition member and comprising a body member 113 and a flange 114 perpendicular thereto, the flange extending into a slot in the core of the partition member 110. The body member 113 is secured to the inner face of the wall by adhesive bonding, riveting or any other convenient means such as the screw fastener assembly 115.

The structure thus described provides a light-weight container of extremely high-strength characteristics. The engineering principles embodied in the present invention are illustrated in FIGURES 9 through 15. FIGURE 9

illustrates a test panel assembly **120** made up of any desired type of sandwich panel such as one with metal or plastic faces bonded to a honeycomb, foamed plastic or a plywood core. The frame elements for loading or unloading the panel are in this case sheet metal strips **121** bonded with a resin adhesive **122** into the core structure.

The core **123** in the panel assembly has a substantially lower shear modulus of rigidity (G) than the facing material **124** and will deform more under load in the plane of the panel without failure occurring. The bond attaching the edge member into the core is also somewhat less rigid than the facing or edge material. A resin adhesive such as an epoxy may be modified with a vinyl resin or other more plastic resin to provide greater flexibility in the joint. The resulting resin may be further modified with a filler and/or a foamer agent to cause the adhesive during cure and set to expand into the core structure reinforcing the core, supporting the faces at the edges, and sealing the faces to the edging member.

In FIGURE 10 it can be seen that a tension load (P) applied to the frame elements will stretch the panel assembly a distance (*d*) depending on the elasticity of the facings and the core. The core, being much more elastic than the facings, will be responsible for the major portion of the elongation (*d*). The work performed in stretching the panel is a product of the average load (P) times the distance stretched (*d*). The distance that point (*b*) moves in relation to point (*a*) is a measure of the work that is absorbed through the core. In addition, and due to the elasticity of the core and bond, the load (P) will be transferred uniformly to the facings over the distance *a*—*c*.

If the frame element had been attached directly to the facing either by bonding or by mechanical means such as rivets or welding, points (*a*) and (*b*) would of necessity move together allowing no absorption of work between the two members thus creating a stress concentration at these points.

In FIGURE 11 it can be seen that if the load (P) were a compression load a similar situation exists and that work will be absorbed through the joint.

FIGURE 12 illustrates a structure like that of FIGURE 8, wherein a normal load (P) acting on the panel causes the panel to bend in flexure. The bending stiffness($E \cdot I_F$) of the panel is measured by the moment of inertia (I) of the panel and the modulus of elasticity of the facing material (E_F). The bending stiffness (EI) of the joint is measured by the moment of inertia of the flange **114** of the frame element (I) and its modulus of elasticity (E). It can readily be seen that the stiffness of the panel construction greatly exceeds the stiffness of the flange. The bending resistance at (*a*) is negligible and the panel is simply supported with little end-movement. Since loads are absorbed by members with the greater stiffness most of the work load will be taken by the panel assembly rather than in the joint construction.

FIGURE 13 illustrates a shock load on the frame element in this case a corner extrusion as described in connection with FIGURES 1–3 being introduced and absorbed along each flange into the core structure of the panel assembly. A significant and substantial amount of work may be absorbed over each lineal inch of the edge member into the panel construction.

FIGURE 14 shows a cross section of a typical box structure **131** with relatively rigid corner frame elements **132** subjected to internal pressure loads (P). Because of the high stresses concentrating in the corner construction, premature failure will occur allowing leaks to develop through the attachment points. Shock loads caused by dropping the box on its corners will also cause stress concentrations at the corners with resulting damage at these points.

FIGURE 15 shows a cross section of a box structure embodying the present invention. The corners, being only as stiff as the leg **32** of the corner member, will yield under load permitting the full panel assemblies to absorb pressure and shock loads.

The legs **32** intersect along a common axis and are flexible relative to the body member **31** and to each other so that they simulate a pivotal or hinge structure. Thus, when the angle between any two joined panels such as the end and side walls **12** and **13** changes due to deformation of the walls under stress, the angle between the legs **32** connected to these walls will also change without offering any substantial resistance. This prevents a concentration of stress in the corner construction, and there is little likelihood of any leaks occurring in these areas.

Having fully described my invention, it is to be understood that I do not wish to be limited to the details set forth, but my invention is of the full scope of the appended claims.

I claim:

1. In a container or cabinet structure, the combination of a pair of intersecting walls, said walls being of panel construction comprising a pair of face sheets and a core, said core being elastic relative to said face sheets in directions parallel thereto, the edge of one wall contacting the other wall, said edge having a recess extending into the core and spaced from said face sheets, and a frame element, said element having a body member connected to the other wall and a flange extending from said body member into said recess, said flange being adhesively bonded to said core for elastic movement of said flange relative and substantially parallel to said face sheets by elastic flexure of said core.

2. The structure of claim 1 wherein the flange is perpendicular to said body member.

3. The structure of claim 1 wherein the body member and flange are relatively flexible.

4. The structure of claim 1 wherein said core comprises a honeycomb core.

5. The structure of claim 1 wherein the intersecting walls form a corner, wherein the edges of both walls are provided with a continuous recess extending into the cores, and wherein the frame element is provided with a pair of flanges, one adhesively bonded to each core.

6. The structure of claim 5 wherein the flanges are operably connected together for relative angular displacement upon displacement of the relative angular relationship between said walls as a result of external stresses.

7. The structure of claim 6 wherein the flanges are mutually perpendicular and relatively flexible.

8. The structure of claim 7 wherein the core is flexibly adhesively bonded to said face sheets.

9. The structure of claim 8 wherein the intersecting walls form a corner, wherein the edges of both walls are provided with a continuous recess extending into the cores, wherein the frame element is provided with a pair of flanges, one adhesively bonded to each core, and wherein the flanges are mutually perpendicular and relatively flexible.

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