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M. PASQUIER

2,288,104

VENTILATED HOLLOW PANEL

Filed Feb. 12, 1940

FIG. 2.

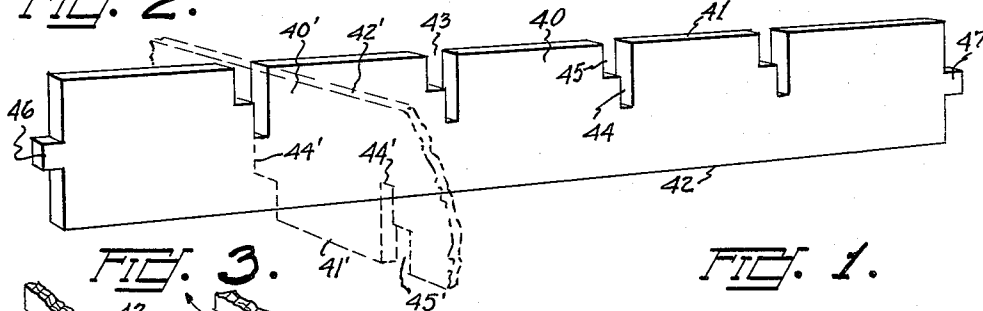


FIG. 3.

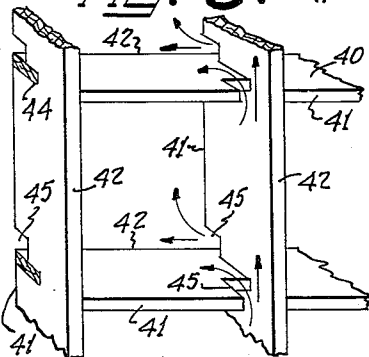


FIG. 4.

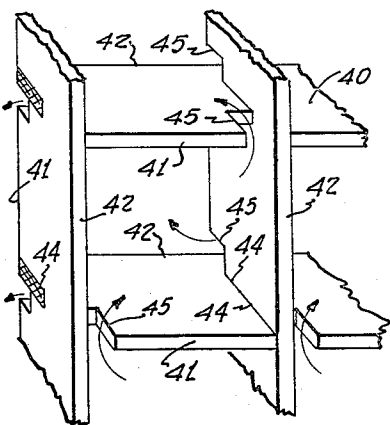


FIG. 5.

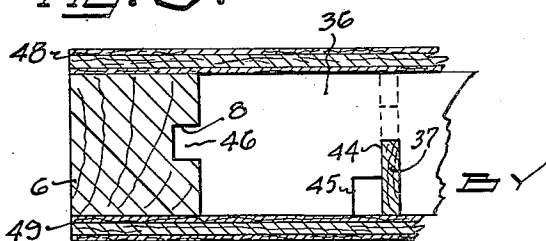


FIG. 1.

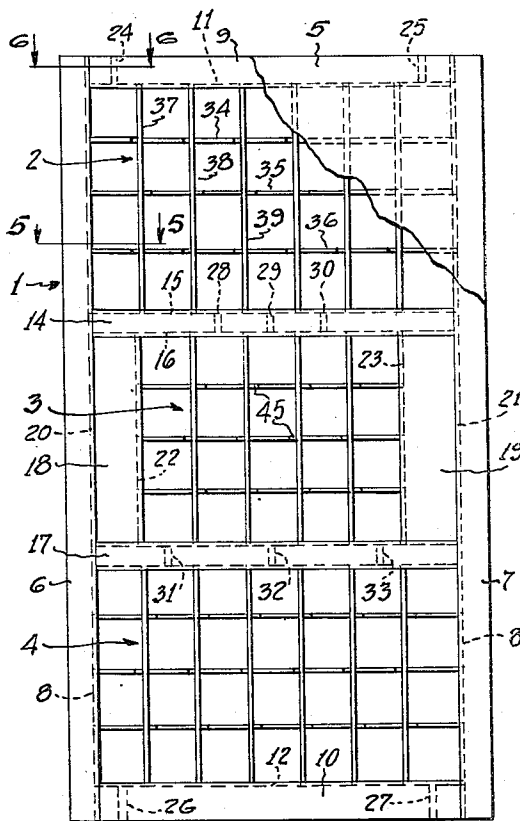
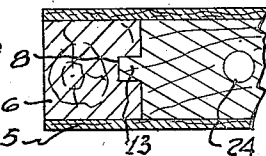


FIG. 6.



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VENTILATED HOLLOW PANEL

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8 Claims. (Cl. 20—35)

This invention relates to improvements in hollow panel construction for buildings, ships, aeroplanes, furniture and the like.

Hollow panels fabricated of wood, or chiefly of wood, have a number of decided advantages over panels constructed of metal, or panels of solid wood. Hollow wooden panels can be made so as to have a much greater strength for the weight of material used than either metal or solid wood panels. Accompanying this strength is the desirable quality of elasticity, or resilience, by virtue of which the hollow wood panel can stand more severe shocks and impacts without suffering a permanent deformation. Hollow wood panels are superior insulators, with regard to the transmission of both heat and sound, and may easily be made substantially fireproof. They can be dressed and fitted by carpenters. They are inherently buoyant in water.

However, any type of panel, to be fully acceptable to the trade, must possess one other requisite, without which all the advantages enumerated cannot prevail. That essential and universal requisite is that the panel be true, or non-warping, and remain so throughout its life. Wood is characteristically little affected by changes in temperature, but it is most annoyingly responsive to changes in moisture content. The cellular nature of wood is such that an increase in moisture content ordinarily causes the wood, or structure composed thereof, to lose its original shape, sometimes only temporarily, and sometimes permanently. The most noticeable and the most objectionable loss of original shape occurs in the form of warping, caused by unequal expansions in the different parts of the piece, or structure.

To eliminate unequal expansion, two principles of wood construction are advanced as a solution to this heretofore troublesome problem. The first principle is to design for a balanced construction. Considering a warped panel as a beam undergoing strain, and having a neutral axis, the first principle teaches that such warping could be prevented by opposing the warp-producing forces on one side of the neutral axis by other forces having an equal and opposite bending moment about the neutral axis. This may be accomplished with the use of wood veneers, first, by forming each structural element, not on the neutral axis, of a plurality of bonded plies having the grains of adjacent plies at right angles to each other. Each such element is then essentially a balanced unit within which the warping forces are substantially balanced, and in which

the lateral expansion in any ply is resisted by the normal grain of one or two adjacent plies, due to the fact that the expansion in the direction of the grain is very slight in comparison with the expansion transversely of the grain. Secondly, if each such composite structural element is balanced by a similar composite element at the same distance on the opposite side of the neutral axis, the bending moment resulting from any over-all linear expansion of one of said elements will be opposed by an equal and opposite moment resulting from an equal linear expansion of the other element, provided the moisture content of the two elements is substantially the same.

The second principle of wood construction herein advanced, then, is that the moisture content of the entire structure, or panel, must be maintained as uniform as possible throughout its various parts. To this end, means is provided for effectively ventilating the interior of the panel to the outside atmosphere, thereby promoting loss of excess moisture from the exposed surfaces interior of the panel. This drying action is especially desirable to prevent the occurrence of unbalanced internal stresses after gluing, when the wood has absorbed an excess of moisture from the glue along the various glue lines.

The object in general of the present invention is, therefore, to provide an improved, non-warping hollow panel. A further object is to provide means for effectively ventilating all the interior compartments of a hollow panel, such as a door or the like, to the outside atmosphere to promote the loss of excess moisture from interior surfaces. A further object is to provide a simple and inexpensive multicellular core composed of all identically cut pieces, and having ventilating openings correspondingly cut in each piece. A still further object is to provide such a core with ventilation paths following glue lines.

These and other objects will be apparent from the following specification and from the attached drawing illustrating by way of example one form of construction, which is at present preferred, to provide a hollow, non-warping panel embodying the general principles set out in the paragraphs above.

In the drawing:

Figure 1 is an elevation view of a panel constructed according to the present invention, and having a part of one of the face sheets broken away to show the novel core construction in place within.

Figure 2 is a perspective view illustrating one

of the core forming strips in full lines, and showing its interfitting relation with a similar, intersecting core strip, the latter being shown by broken lines.

Figure 3 is a fragmentary perspective view of a portion of the core construction illustrating one manner in which the identically slotted core pieces may be fitted together to provide lines of ventilation adjacent glue lines on the faces of the core member.

Figure 4 is a fragmentary perspective view showing another manner in which the identically slotted core strips may be interfitted together to provide paths of ventilation different from those illustrated in Figure 3.

Figure 5 is a sectional view taken on the line 5-5 of Figure 1.

Figure 6 is a sectional view taken on the line 6-6 of Figure 1.

Figure 1 illustrates a completely assembled panel constructed according to the present invention, and comprises a frame member indicated generally at 1, core members indicated generally at 2, 3 and 4, and a front face sheet indicated generally at 5. The rear face of the illustrated assemblage is understood to be covered by a second face sheet similar to sheet 5.

The frame, indicated generally at 1, is illustrated as being composed of a number of pieces. Longitudinally medially grooved stiles are shown at 6, 7. The longitudinal medial grooves in the said stiles are shown best at 8 in Figures 5 and 6. Connecting the stiles 6 and 7 are a plurality of similarly longitudinally medially grooved rails. These rails may be only two in number, being disposed solely at the top and bottom edges of the frame, but in the present embodiment four rails are illustrated, the top rail 9 and the bottom rail 10 having their longitudinal grooves indicated at 11 and 12, respectively. In the top and bottom rails 9 and 10 the grooves are formed only in the inner edges of said rails as the latter are arranged in the assembled frame. The rails 9 and 10 are provided with a tenon 13 in each end thereof, as best illustrated in Figure 6, the said tenon snugly interfitting with the groove 8 in each of the respective stiles.

The rail 14 is located in a mid portion of the panel and is in general similar to the rails 9 and 10, except that it is longitudinally medially grooved on both sides, as indicated at 15, 16. Its end portions are equipped with tenons to fit in the grooves 8 in the stiles in the same manner as the top and bottom rails, as illustrated in Figure 6. A second intermediate rail is provided at 17, this being similar in all respects to the rail 14.

Short auxiliary stiles 18, 19 are provided between the intermediate rails 14 and 17 for receiving hardware such as a latch to be mounted therethrough. The auxiliary stiles 18 and 19 each have a longitudinal tenon or tongue 20 and 21, respectively, for retention in the grooves 8, said auxiliary stiles themselves being provided on their opposite edges with similar grooves 22 and 23.

The structure thus far described constitutes what may be called the frame of the panel, and when faced on its opposite sides with sheets co-extensive therewith, encloses dead air spaces sealed off from communication with the ambient atmosphere. Provision is made, however, for ventilation access from these several chambers to the ambient atmosphere. For this purpose the top and bottom rails 9 and 10 are provided with

ventilation holes or apertures 24, 25, 26 and 27 in the manner illustrated. The upper intermediate rail 14 is illustrated as being provided with three ventilating apertures located at 28, 29 and 30. The lower intermediate rail contains the ventilating apertures 31, 32 and 33 extending from the top to the bottom sides thereof.

For reasons well understood in the art, core members, indicated generally at 2, 3, 4, are supplied to fill the spaces in the frame between the rails and stiles in two directions, and between the face sheets in the third direction. The specific construction of the core members constitutes one of the features of novelty of the present invention. In Figure 1 the core member 2 is illustrated as being composed of horizontal core strips 34, 35, and 36, and vertical core strips 37, 38, 39, etc. In practice it is found desirable to space the core strips from three to four inches apart in each direction. The manner in which these various core strips are interfitted to form a multicellular, reinforcing structure is illustrated in Figures 2, 3 and 4, particular attention now being directed to Figure 2. It is pointed out that the various core strips are all identically sawed, or slotted, so that the only difference between different core strips will be in the matter of length. That is to say, that all the horizontal core strips 34, 35 and 36 will be absolutely identical in all respects, and that all the vertical core strips 37, 38, 39, etc. will likewise be identical with each other and will differ from the horizontal core strips only in the length and the number of slots cut therein.

It will be understood, then, that the core strip 40 illustrated in Figure 2 may be considered a typical core strip and may represent any one of the individual core strips illustrated in Figure 1, its only mark of identification being its length. For purposes of description, the core strip 40 will be described as having two edges, one of these edges being a slotted edge, as indicated at 41, and the other edge being an unslotted edge, as indicated at 42. The slots are indicated generally at 43 and are stepped on one side thereof to provide a deep portion 44 of reduced width and a wide portion 45 of reduced depth. In the preferred embodiment the deep portion 44 extends substantially half way through the strip so that it may be interfitted with a similarly cut slot in an intersecting strip 40', but of course the same interfitting relationship could be obtained by making the depth of one of the interfitting slots less than half the width of the strip, and the depth of the companion slot greater than half the strip. The width of the deep portion 44 is substantially equal to the thickness of the strip, so as to snugly engage an intersecting and interfitting strip. The depth of the portion 45 may be any amount substantially less than the depth of the deep portion 44. The exact width, and shape, of the wide portion 45 is immaterial to the present invention, as long as it will perform the functions to be later described, and such width may be attained wholly on one side of the deep portion 44, or on both sides thereof. In the preferred embodiment the wide portion 45 lies wholly to one side of the deep portion 44, one wall of the slot 44 extending continuously from the edge 41 to the bottom of the said deep portion. In Figure 2 the primed numerals indicate corresponding parts in an intersecting strip, shown in broken lines, which is identical with the strip 40 shown in full lines. Thus, the slotted edge of the intersecting strip is indicated at 41', the unslotted edge at 42'; the deep portion of the slot having

reduced width is shown at 44'; and the wide portion having reduced depth is shown at 45'.

Each of the core strips 40 is provided at its ends with tenons 46 and 47 to engage and be retained in the previously mentioned grooves in the oppositely disposed rails and stiles, respectively. The tenons 46, 47 in the horizontally disposed core strips 34, 35 and 36 are seated in the grooves 8 of the stiles 6 and 7, respectively, while the tenons on the ends of the vertically disposed core strips 37, 38, 39 etc. are secured in the opposed grooves 11 and 15 in the rails 9 and 14, respectively, thus insuring that the completely assembled core 2 will form a structural unit with the frame 1. The detailed view in Figure 5 illustrates how the tenon 46 in the core strip 36 fits into the longitudinal groove 8 in the stile 6. There is also shown in this figure the first vertical core strip 37 adjacent the stile 6.

It is to be understood that the core member 4 is identical with the core member 2, and that the core member 3 is identical with the core member 2, except for its reduced width by reason of the auxiliary stiles 18 and 19. The tenons on the ends of the horizontal core strips in the core member 3 engage the grooves 22 and 23 in the auxiliary stiles 18 and 19 in the same manner as the tenons 46 of the horizontal core strips 34, 35 and 36 in the core member 2 engage the grooves 8 in the stiles 6 and 7.

In the finished panel, face sheets such as the plywood members 48 and 49 will be glued to the frame member 1 and to the edge surfaces of the assembled core strips 40, the width of said core strips being the same as the thickness of the several rails and stiles comprising the frame member. Thus each of the narrow edge surfaces 41 and 42 constitute a glue line with the face sheets 48 and 49. When the wet glue is applied thereto the moisture content of the wood in the area receiving an application of glue will be increased. The provision of lines of ventilation through air holes, or slots, adjacent and along the glue lines will then be especially efficacious in removing excess moisture from those parts of the wood, and restoring a uniform moisture content in all parts of the panel.

It will be seen from Figures 3 and 4 that different systems of ventilation may be produced by assembling the identically slotted strips 40 in different manners. If it is desired to obtain a line of air flow, or ventilation, along certain glue lines between the assembled core and face sheets glued thereto, the wide portions 45 of the slots may be aligned entirely through the core member, as illustrated by the fragmentary portion of the core shown in Figure 3, where the directions of straight line paths of ventilation are indicated by straight arrows. In Figure 3 there are illustrated two horizontal lines of ventilation flowing along two horizontal glue lines, respectively, and one vertical line of ventilation following a vertical glue line. These lines of ventilation are the most direct, but the air movements within the core could also take other paths, as illustrated by the curved arrows.

Figure 4 illustrates a manner of assembling the core pieces in which the wide portions of the slots in adjacent parallel core pieces are reversed to provide a zig-zag path of ventilation through each cell. The core strips forming the cell illustrated in Figure 4 are, however, identical with the core strips forming the cell illustrated in Figure 3, the sole difference in the cell structure being effected by the manner of assembling and

interfitting the strips with each other. It will be noted in Figure 4 that by reversing alternate parallel strips, both horizontal and vertical, all direct straight line paths of ventilation are eliminated, and the shortest path from one intercell opening to another is at least equal to the diagonal of one side of the cell, as indicated by the arrows.

Other directions of ventilating air flows could be obtained by selecting other arrangements for the intersecting and interfitting strips 40. For instance, either the horizontal or the vertical strips could be arranged with their openings aligned in the manner of Figure 2, and the intersecting strips arranged with their slots alternating in the manner of Figure 4. Then there would be provision for an air circulation in parallel paths in one direction and in diagonal paths in the other direction through the core. In any event, irrespective of the manner of assembling the strips 40, there will be provided an innercell ventilating opening at the apices between adjacent walls of each polygonal cell. Also each intersection of the strips 40 will provide two intercell openings, one adjacent each face sheet, so that the regions of greatest glue concentration will be assured of direct ventilation. Thus each cell in the multicellular core is in either direct or indirect ventilating communication with every other cell, and the whole core may be ventilated to the ambient atmosphere by means of only a few openings through the frame. In the present embodiment the openings in the outside members of the frame are illustrated as located in the corners thereof and communicating with the corner cells therein, while the ventilating openings in the intermediate rails have their locations varied in the manner illustrated. This arrangement of ventilating apertures through the various frame members is intended as illustrative only, and not as a limitation in the manner of practicing the invention.

For simplicity of construction, the core members are illustrated as having one set of strips disposed in a vertical direction, and parallel to the stiles, and another set of strips intersecting the first set at right angles, and parallel to the rails. In practicing the present invention, however, it is not necessary that the core strips intersect at right angles or that all of them, or any of them, be disposed parallel to either the stiles or the rails.

For purposes of illustrating a balanced, non-warping construction, the face sheets 48 and 49 may be described as plywood veneers, three-ply sheets being illustrated. Other numbers of plies can be used in the making of the face sheets provided that the grains of adjacent plies are arranged at right angles. For certain purposes it may be desired to include a metallic sheet between two of the plies, or in substitution for one of the plies illustrated. The numeral 5 in Figure 1, therefore, represents a face sheet generally, which may or may not be of the specific type illustrated at 48, 49 in Figure 5. The ventilating means, arranged to be especially effective in connection with the many glue lines between the core strips and the face sheets, tends to quickly eliminate the non-uniformity of moisture content of the structure or panel, so that the advantages of a theoretically balanced design will not be lost. After the glue has dried and set, the exterior ventilating holes in the frame may be plugged, if desired.

Having now described my invention and in

what manner the same may be used, what I claim as new and desire to protect by Letters Patent is:

1. A hollow panel comprising a pair of longitudinally medially grooved stiles; a pair of longitudinally medially grooved rails connecting said stiles at their ends to form a rectangular frame; other rails connecting said stiles intermediate their ends, each rail having a tenon at each end thereof engaging one of said grooves in said stiles and being also longitudinally, medially grooved; a plurality of strips, each strip having one edge slotted and one edge unslotted, arranged in spaced relation between and parallel to said stiles; a second plurality of strips, each strip having one edge slotted and one edge unslotted, arranged in spaced relation between and parallel to said rails, each of said strips having at each end thereof a tenon engaging one of said grooves; the slots in said strips being stepped and formed for interfitting engagement, portions of the slots in said second plurality of strips being interfitted with portions of the slots in said first plurality of strips so as to create a multicellular core in which each cell has ventilation access to each of the surrounding cells by way of the remaining portions of said slots, openings in each of said rails to establish ventilation access from said cells to the ambient atmosphere; and plywood face sheets covering both faces of said panel.

2. A hollow panel comprising face sheets glued on opposite faces of a multicellular core structure, the cells of said core structure being formed of intersecting and interfitting strips, each of said strips having stepped slots spaced along one edge thereof, each of said slots having a wide portion of reduced depth and a deep portion of reduced width, the deep portions of said slots on each strip interlocking with the deep portions of slots on intersecting strips, and the wide portion of each slot forming a line of ventilation adjacent a glue line between one of said face sheets and one of said strips.

3. A hollow panel comprising longitudinally grooved stiles, longitudinally grooved rails having tenons in the ends thereof engaging the grooves in said stiles so as to form a frame, intersecting core strips having tenons on the ends thereof engaging said grooves, said strips being identically slotted at their points of intersection, a portion of each slot providing ventilating communication through said strips, and apertures in said frame to provide continued ventilating communication with the ambient atmosphere.

4. A ventilated hollow panel comprising a frame member, a multicellular core in said frame member and consisting of a plurality of intersecting and interfitting core strips defining polygonal

cells, face sheets glued to both sides of said frame and to the edges of said core strips, said core strips being slotted at each intersection to provide intercell ventilation openings in corners of each cell and adjacent each of said face sheets, there being at least one ventilation opening at each intersection against each of the two face sheets, and openings in said frame member to provide ventilation between said cells and the ambient atmosphere.

5. A hollow panel comprising face sheets glued on opposite faces of a multicellular core structure, the cells of said core structure being formed of a first plurality of strips having stepped slots spaced along one edge thereof, a second plurality of strips having stepped slots spaced along one edge thereof, said second plurality of strips being interfitted with said first plurality of strips so that each of said steps forms an intercell opening adjacent the edge of a juxtaposed strip.

6. A hollow panel comprising face sheets glued on opposite faces of a multicellular core structure, the cells of said core structure being formed of a plurality of identically cut strips, each of said strips having one continuous edge and one slotted edge, each of said slots having a wide portion of reduced depth and a deep portion of reduced width, said deep portions being adapted for mutually interfitting engagement, said strips being held by said engagement in intersecting relationship in which the wide portion of each slot provides a ventilation access to each cell in an end portion thereof.

7. A hollow panel comprising face sheets glued on opposite faces of a multicellular core structure, the cells of said core structure being formed of a plurality of slotted intersecting and interfitting strips, said strips having said slots spaced along one edge thereof, each of said slots having a deep, parallel-walled portion for interfitting engagement, and at least some of said slots having wide portions of reduced depth to provide ventilation access between end portions of adjacent cells.

8. A hollow panel comprising face sheets glued on opposite faces of a multicellular core structure, the cells of said core structure being formed of substantially similar intersecting and interfitting strips, each of said strips having one slotted edge and one continuous edge, each of said slots having a wide portion of reduced depth and a deep portion of reduced width, said deep portions being adapted for mutually interfitting engagement with the deep portions of other similarly slotted strips, said wide portions being adapted for ventilation openings within said panel.

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