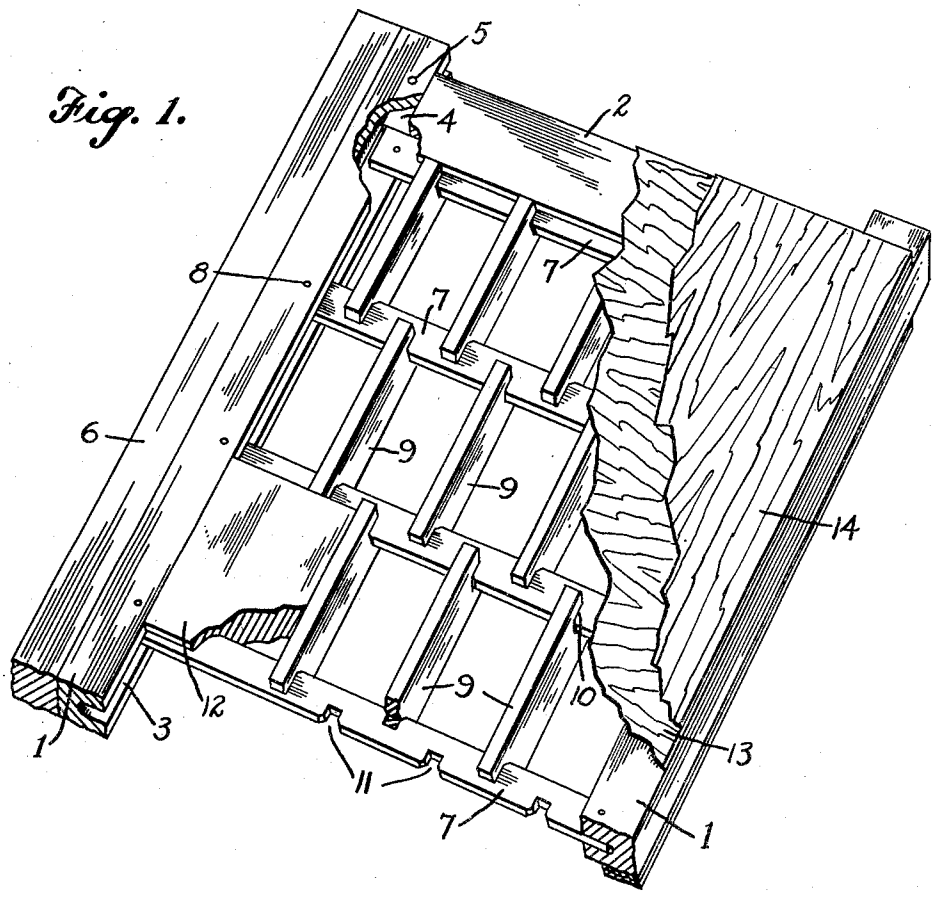
Sept. 22, 1953 J. R. BURKE 2,652,600

COMPOSITE PANEL

Filed Feb. 13, 1950

Fig. 1.



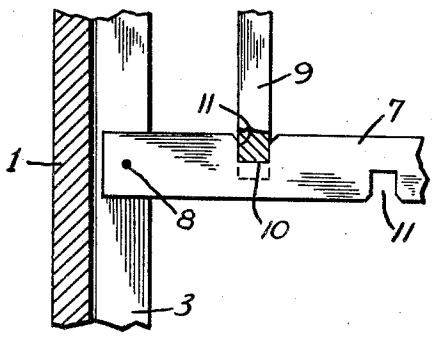


Fig. 3.

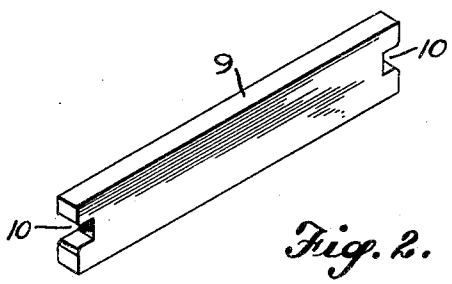


Fig. 2.

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COMPOSITE PANEL

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5 Claims. (Cl. 20—35)

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The present invention concerns a composite panel, illustrated as embodied in the form of a flush door of appreciable overall thickness, and is particularly, though not exclusively, applicable to such panels as employ at one or both surfaces usually two, but sometimes only one, or sometimes more than two, adhesively joined veneer laminations, such as an outer wood veneer face and an inner wood veneer cross band or lamination, the innermost whereof is adhesively secured to each of the marginal frame and a core, which core and frame are of like, and quite appreciable, thickness. Panels of this sort are employed, for instance, in the making of desk tops, table tops, and the like, and even in prefabricated wall panels, but are used in large numbers as doors. The present invention will be described in connection with doors, by way of illustration, but without any intention of limiting the application of the invention thereto, since its principles and constructional features are applicable to panels of various types, as has already been indicated.

Flush doors of this type should be of light weight, quite rigid, and not subject to warping, "waffling," "washboarding," or other distortion, yet must be of some appreciable thickness, and apparent solidity. They must have a minimum of exposed end grain, to minimize absorption of moisture and resultant swelling and shrinkage. Experience has shown that such ends can best be achieved by making the door largely hollow and self-trussed, with a rigid marginal frame, the center whereof is filled with a core, in the form of construction which is generally termed a "hollow core door," and various forms of the hollow core have been proposed heretofore. In one such type of door the core comprises a series of narrow, closely spaced strips extending longitudinally in one continuous piece from one rail of the marginal frame to the other, and a similar series extending laterally and unbrokenly from one stile to the other, the longitudinal and the lateral strips being complementally internotched, so that the edges of all strips lie in the planes of the marginal frame, and the door's faces are adhesively secured upon the frame members and the strips. This type of core is ordinarily termed a honeycomb core, and one form of construction thereof is shown in the Pasquier patent, No. 2,288,104, dated June 30, 1942.

The door of my present invention is a "hollow core door," but the core is of a type different from the honeycomb core, and as a result the door as a whole possesses characteristics and advantages differing from those of prior doors.

The panel of this invention has been referred to hereinbefore as "self-trussed." This might infer that the core is made inherently so rigid overall, and has its components so rigidly connected one to another, that it will not in detail nor overall depart from its initial shape, whether under the influence of stresses arising within the core or under the influence of stresses applied to the core by the adhered faces, or of stresses applied to the door as a whole during use; that the thus-rigid core will prevent deformation overall or in detail of the faces. Such a theoretically desirable construction is not practically possible, no more so than a wholly rigid airplane wing is possible. Rather than attempt to attain such rigidity, as others in the past have unsuccessfully attempted, and as is one of the objectives of the honeycomb core, I purposely forego any attempt to make the core rigid, and as do the makers of airplane wings, combine the faces, or skin, in such manner with core elements that are overall nod-rigid, and non-rigidly connected—indeed, relatively slightly shiftable—so that the skin or faces assume a share of the stresses, and when shrinkage or swelling tends to cause any local part of the skin or face to extend, or contract, or to warp, or to buckle, the core elements affected thereby may shift slightly relative to other core elements, in compensation, to relieve the stresses otherwise produced. If this were not possible, and if the core were so rigid that the core elements could not shift relative to other core elements under the influence of stresses originating in the skin, then no matter how rigid the core might be, the intervening portions of the face would "waffle," or "washboard," or with anything less than absolute rigidity of the core throughout (impossible to obtain with wooden elements some six feet long, three feet more or less in width, and slightly in excess of an inch in thickness) warping would occur, or other such overall distortion.

The honeycomb type of door already referred to has the important advantage, over earlier forms of solid-core and hollow-core doors, that it is light and reasonably strong, but there are recognized drawbacks which limit its usefulness. For one thing, the core pieces must be of high grade, expensive lumber, which is hard to obtain in adequate quantities, for otherwise they will break up in the notching and assembling operations. Even so, they are formed of thin pieces, placed on edge, the longitudinals approximating six feet long, and they will stand but little pressure during application of the faces; excessive pressure tends to twist them and to break them, and so they will not resist a pressure such as is required to effect adhesion of two face plies each throughout its entire area to the respective cross-band plies, and the latter to each face of the cord, all in one gluing operation, as can be done with the core of this invention. Rather, it is customary to assemble the two faces (often of more expensive three-ply material) in advance

of application thereof to the honeycomb core (with the added cost of multiple or separate operations), in order that the stiffer faces, the plies whereof are already adhered to one another, can be adhered to the core with but light pressure, and no one core piece will have to assume heavy pressure. In addition, such honeycomb cores have thin, edge-placed core pieces which extend some longitudinally and some transversely, but all with their edges in the same general plane as the surfaces of the core's marginal frame. Each such edge is notched at rather frequent intervals. If the two-ply faces are to be glued to the core and to each other in a single operation, the notching must be frequent enough to leave a minimum of unsupported area to take the requisite pressure; only if the previously made, hence inherently stiff plywood is used as faces can the notching be at greater intervals. Such a core can not be sanded by a panel sanding machine, for the edges would be broken off in many places, yet unless the core's surfaces are absolutely and uniformly plane, and are thus planed or sanded immediately prior to the face-applying operation, the irregularities in the core, where a core strip is higher or lower, or is broken, will show through the faces, and especially if these faces be only two-ply, and such irregularities will become increasingly apparent as moisture-induced changes occur in the door.

Still further, the very regularity of the honeycomb pattern, and such rigidity as it possesses, are disadvantages that lead to pronounced "waffling" in time, and again, this is especially the case if the lighter, cheaper, and preferable two-ply faces are used. The cross-band, or more correctly, the innermost ply of the face, whether it be the cross-band ply of a two-ply face or the longitudinally grained face of a three-ply face, will adhere to the edges of the crossed core strips. Initially the adhesion secures the sanded flat inner ply to the more or less flat surface defined by the core strips' edges and the marginal frame. As time passes, the faces and the core absorb, or lose, moisture at a rate differing from the rate of absorption, or loss, of the other. The adhesion persisting, unless the core yields somewhat, "waffling" of the face's surface occurs, in a very regular and highly noticeable pattern. The faces being adhered in repeated small squares, defined by core elements held as rigidly as possible relative to the other core elements, there is no place for the swelled or buckled face to go, so it "waffles."

With this honeycomb core, and with all other cores wherein longitudinals are continuous over any appreciable length, or where cross pieces and longitudinals are both of the same thickness as the core itself, or where core pieces are rigidly fixed relative to adjacent core pieces so that they can not shift slightly relatively as swelling or shrinking occurs, the stresses set up by moisture changes can not be relieved automatically, and soon become manifest in warping of the door overall, or in "waffling," in "washboarding," or in like effects which render the door at least unsightly, and sometimes unusable.

"Waffling" or "washboarding" can arise, also, in doors having core pieces oriented and arranged in generally, or even specifically, the same manner as are the core pieces in this invention, unless the core assembly as a whole is sanded perfectly plane and smooth immediately before application of the faces. I so learned by sad experience. If any individual core piece lies below, or above, the common plane, the adhered faces will be depressed, or raised, at that point. It is uneconomical to plane or sand each individual piece, and if this were to be done, nonuniformity of finishing and fitting would still produce unevenness of surface in the assembled core and in its applied faces. It is therefore highly desirable that the assembled core be capable of being handled as a unit, without likelihood of displacement of individual core pieces, and sanded after assembly, but even so, moisture changes will in time produce unequal changes in different core pieces that have been thus sanded after assembly, if they are set aside for future facing, and my experience has shown that sanding of the core assembly immediately prior to application of the faces, regardless of whether they had or had not been so sanded before, is necessary to the full attainment of the desired results.

The same defects, "waffling" or the like, have been found to occur with short core elements such as herein shown, assembled and sanded as herein described, if, in the course of their assembly, they are crowded or held by gluing to one another or all to the skin, so tightly together that each one has not some freedom of individual movement, as may be required by shrinkage or swelling of the faces, one relative to another. For example, in my earlier-filed and now abandoned application, Serial No. 60,040, filed November 15, 1948, the longitudinals were crowded into contact at their ends, and hence could not shift laterally, one relative to another, as the glued-on face swelled or shrunk. In all other important respects that earlier structure paralleled the present arrangement, and yet it sometimes "waffled" and proved occasionally unsatisfactory in this respect, notwithstanding its novelty and its desirability in other respects.

It is the primary object of this invention to provide a core, and a door or like panel incorporating the same, wherein the core pieces are so spaced, assembled, and relatively oriented, are of such small size, and are so accurately and fixedly yet somewhat shiftably held, relative to one another, as to provide sufficient yieldability to accommodate the expected moisture changes in the faces, core elements, and door as a whole, without warping or "waffling," and yet of sufficient strength and overall unity to permit assembly and gluing in one operation of a door with only two face plies at each face, such as has been heretofore most susceptible to warping and "waffling," besides being made of very low-grade, low-cost, short-length material readily available, but used in such a way that there need be no fear of breakage, and assembled so securely and in such orientation that the core assembly can readily be sanded perfectly smooth and flat just prior to application of the faces.

In the attainment of that object I attain certain other important objects, among them the provision of a very light-weight door, and a relatively low-cost door, yet one which is entirely strong enough for all normal purposes, and one which will maintain its shape and its smooth appearance, in virtually all climates and under great extremes of moisture and temperature.

A still further object is to provide a core in which all elements, including the marginal frame parts, the longitudinals, and the cross strips, are so designed that each can be formed automatically, or semi-automatically, and therefore inexpensively, by machinery readily available in

normal wood-working plants, such as a double-end tenoner.

With such advantages, and others as will appear hereinafter, the present invention comprises the novel panel or door, as shown in the accompanying drawings, and as will be explained more particularly in this specification and defined in the claims which terminate the same.

Figure 1 is an isometric view of an end of such a door, various parts being broken away or shown in section, the better to illustrate interior construction.

Figure 2 is an isometric view of an individual core strip, of which there are many in such a door.

Figure 3 is a detail sectional view on a plane intermediate the faces of such a core, illustrating details of construction.

The door incorporates a marginal frame, consisting of uprights or stiles 1 and rails 2, which are connected together in any normal manner, as by means of the grooves 3 in the inner edges of the stiles 1, wherein are received tongues 4 formed at the ends of the rails 2. Exposure of the moisture-absorptive and somewhat unsightly end grain of the rails is thus avoided. Pins or similar securing means, as indicated at 5, are preferably employed as the sole means of retaining the parts of the frame together. Where the outer facing of the door is to be of a particular kind of wood, an edge strip 6 of this same wood may be employed at the outer edge of one or of both stiles, so that the door appears to be constructed entirely of the same kind of wood. Such details of door construction are common in the art, and of themselves are not an essential part of the present invention.

It is in the core that is mounted in such a marginal frame, and the relationship of the core parts to the frame, to the face or faces, and to one another, that the novelty of the present invention primarily resides. Such a core is built up, according to the present invention, by the employment of a plurality of cross strips 7, one received in the groove of each rail that corresponds to the groove 3, and others spaced at intervals in the length of the door and extending across from one stile to the other. When the stiles are grooved, as at 3, the cross strips 7 may be of such length that their ends are received in the grooves 3, and they may be pinned at 8, or in any equivalent manner secured at the proper spacing in the stiles. These cross strips are conveniently formed of narrow widths of plywood, having thereby some flexibility, yet adequate stiffness and strength. Importantly, they are thinner in the direction of the thickness of the marginal frame than such frame, and are inset from the face or faces thereof, so that they—and they are the sole transverse elements of the core—cannot at any point reach the plane of the face of the marginal frame, nor contact the facing which later is applied to the frame and core.

The spacing between the cross strips 7 is determined by the length of the filler blocks or core strips 9, of which several series or rows are employed, each row extending from one cross strip 7 to the next, and being engaged at their ends with the cross strips for their sole support, and preferably being interengaged or interfitted with the cross strips to hold the core strips 9 in their intended spaced-apart position relationship, each one relative to the others. These core strips 9 extend lengthwise of the frame, and are of such dimension in the direction of the thickness of the

frame as to be exactly equal in this dimension to the thickness of the marginal frame itself. How and when they are made equal thus will be explained later. They need not have any great thickness in the transverse direction, but are spaced apart, the exact spacing being largely a matter of choice or design, but sufficient that there is no contact between them, as there was in my now abandoned application Serial No. 60,040, but preferably a wide gap. Additionally, and preferably, the core strips 9 in any one row, that is, between any two cross strips 7, are staggered with relation to the core strips in the series at either side thereof, but aligned with the core strips 9 of alternate rows, as is clearly shown in Figure 1, so that there is lack of longitudinal continuity over any long distance. In addition the core strips should be long enough that the ends of strips in one row will project past the ends of the core strips in the two adjacent rows, so that no definite line of demarkation at or between their ends can show through the facing.

The fixation of the core strips in the positions described may be achieved in any one of a number of convenient ways, and as illustrated, each core strip 9 is notched at its ends, as indicated at 10, and the cross strips 7 are preferably correspondingly notched, as indicated at 11, at proper intervals. The snug engagement of notches 10 about the cross strips 7 supports the core strips 9 and the interengagement of the notches 10 and 11 serves as the means of fixing the core strips in proper position and spacing. It also serves to locate the cross strips in the event pins 8 or equivalent means are not employed, but usually, and preferably, such pinning means are employed.

It is obvious that a solid filler block 12 may be inserted in the same manner between cross strips at any point where solid wood is desirable, as, for instance, at a location to receive the lock, but this is the exception and not the rule.

The core is assembled thus by setting up the marginal frame with the cross strips 7 and the core strips 9 in properly assembled relationship, and after all transverse parts are pinned or otherwise secured in their assembled positions, it is preferred that the so assembled frame and core be sanded on both sides. This brings all parts into exactly coplanar relationship. The edges of the discontinuous longitudinal core strips 9 are at precisely the same level as the faces of the marginal elements 1 and 2. Immediately after sanding, in order that moisture may not alter the precise planar relationship, the facing is applied, preferably adhesively, and the number of laminations therein is a matter of choice, or of expense. Preferably the facing is of two plies, consisting of a cross grained face or lamination, indicated at 13, which lies directly upon the core and frame, and the outer or overlying finish face 14, wherein the grain extends lengthwise of the door. Preferably both plies of both faces are adhered, one to another and the inner faces to the core, all in one pressing. The inner face of the lamination 13 contacts and is secured adhesively to the frame elements 1 and 2 and to the edges of the core strips 9, but the cross strips 7, being inset beneath the level of the edges of the core strips, have no direct connection with the lamination 13, nor has any other element in contact with this lamination any continuity laterally, for it is the fixation caused by this, or by any similar effect, that causes "washboarding" or "waffling." The lamination 14, or finish face, is adhesively secured over the entire lamination 13, the facings truss

the core, and the core and frame stiffen the door as a whole. Because of the absence of any transverse connections to the face, and because the core strips 9 extend generally transversely of the grain of the under face or lamination 13, and are not continuous, it has been found that the "waffling" effect is completely eliminated, and the finish face 14 lies wholly smoothly indefinitely, and its surface is unbroken or unindented.

The core strips 9 may be formed of short lengths of lumber, such as might otherwise be scrap, and require no finish operations other than their finishing to required lengths, and the notching of their ends, at least prior to the sanding of the frame and core as a subassembly, just prior to application of the faces. By reason of their wide spacing, free circulation of air throughout the core and evaporation of moisture is encouraged, particularly as the tongues 4 would normally not seat wholly in the bottom of the grooves 3, and moisture from the drying glue can escape at these points. The core is light in weight, and relatively inexpensive. It is readily assembled and parts are positively retained in their assembled position. Indeed, for ease of assembling, each of the notches 10 and 11 is preferably chamfered slightly at their entrance, as is clearly seen in Figures 1 and 2. Notwithstanding the positive securement of each core strip at its edges to the faces, each strip is sufficiently loosely assembled in the core, that is to say, with relation to its sole support on the cross strips 7, and hence with relation to all other core strips, that stresses transmitted to individual core strips from the faces are not transmitted to and resisted by a rigid core as a whole, but can be relieved within or by minute displacement of each individual core strip.

I claim as my invention:

1. An elongated composite panel, such as a hollow core door, comprising wooden stiles at the two longer side edges and wooden rails at the two shorter end edges, all of like and substantial thickness and joined fixedly together to define a marginal frame; two thin faces each consisting of an inner ply of wood veneer adhered to said marginal frame, and disposed with its grain generally parallel to the rails, and an outer ply of wood veneer adhered over its entire surface to said inner ply, and disposed with its grain generally parallel to the stiles; a plurality of separate wooden core strips disposed within the marginal frame all parallel to one another and to the stiles, each of a thickness equal to the thickness of the marginal frame, of a length only a fraction of the length of the stiles, and of a width a minor fraction of the spacing between stiles, and distributed generally evenly throughout the space within the marginal frame in spaced-apart relation in transverse rows; cross strips submerged between and out of contact with the faces, extending between and supported by the opposite stiles, and located intermediate and supportingly interengaged with the ends of core strips in each of two adjoining rows, and at the ends of the two terminal rows, to hold the core strips generally in their spaced-apart disposition, yet for slight shifting with relation to adjacent core strips as required by change in moisture conditions, the inner ply of each face being adhered to the outer edges of all the core strips, as well as to the marginal frame.

2. An elongated composite panel, such as a hollow core door, comprising wooden stiles at the two longer side edges and wooden rails at the two shorter end edges, joined fixedly to the stiles to define a marginal frame, all the stiles and rails being of like thickness; two thin faces each including a plurality of plies of wood veneer, of which the inner ply is adhered to said marginal frame and the outer ply or successive plies, as the case may be, is or are adhered over the entire area of the next inner ply, thus to enclose all the space within the marginal frame; the grain in the outer ply of each face extending parallel to the direction of the stiles, and the grain in the next inner ply extending parallel to the direction of the rails; a plurality of separate wooden core strips, all oriented parallel to one another and to the stiles, each of a thickness equal to the thickness of the rails and stiles, but of a length only a fraction of the length of the stiles, and of a width a minor fraction of the spacing between stiles, said core strips being distributed generally evenly throughout the enclosed space, in spaced-apart relation in transverse rows; cross strips submerged between and out of contact with the faces, extending between and supported by the opposite stiles, and located intermediate the ends of core strips in each of two adjoining rows, and at the ends of the two terminal rows, the inner ply in each face being adhered to the outer edge of each core strip, in addition to the marginal frame, and the several cross strips being supportingly interengaged with the corresponding core strips to hold the latter generally in spaced-apart disposition, yet for slight shifting with relation to adjacent core strips as required by shrinking or swelling of a face ply or plies, particularly transversely of the ply's grain.

3. A composite panel as in claim 2, wherein the core strips in alternate rows are located and held in alignment lengthwise of the frame, and the core strips in the intervening rows are likewise located and held in alignment lengthwise of the panel, but staggered relative to and spaced from the core strips in the first-mentioned rows.

4. An elongated composite panel as in claim 3, wherein the core strips in each row are of such length, and so arranged relative to the several cross strips intermediate adjoining rows, that the core strips in a given row extend longitudinally beyond the ends of the core strips in the adjoining rows.

5. An elongated composite panel as in claim 1, wherein the core strips' ends and the cross strips are inter-notched at each meeting point, to retain the core strips from appreciable displacement transversely of the general plane of the panel, and from appreciable displacement transversely of the panel or from general parallelism with all other such core strips.

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