

Sept. 8, 1942.

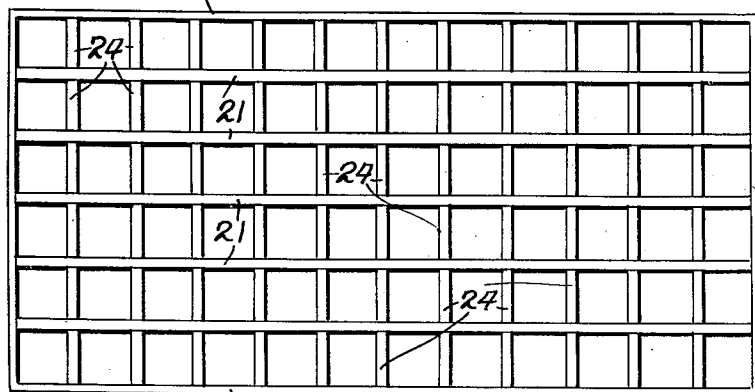
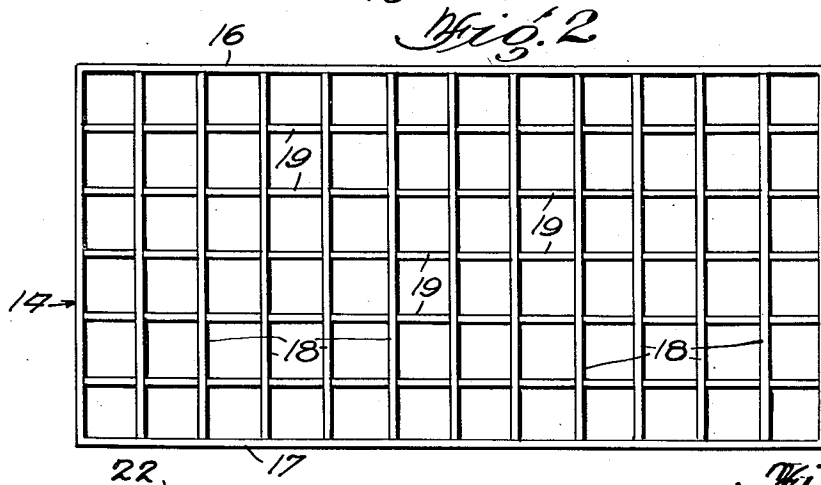
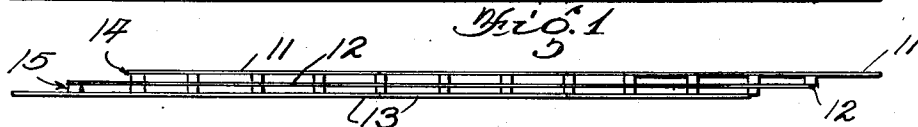
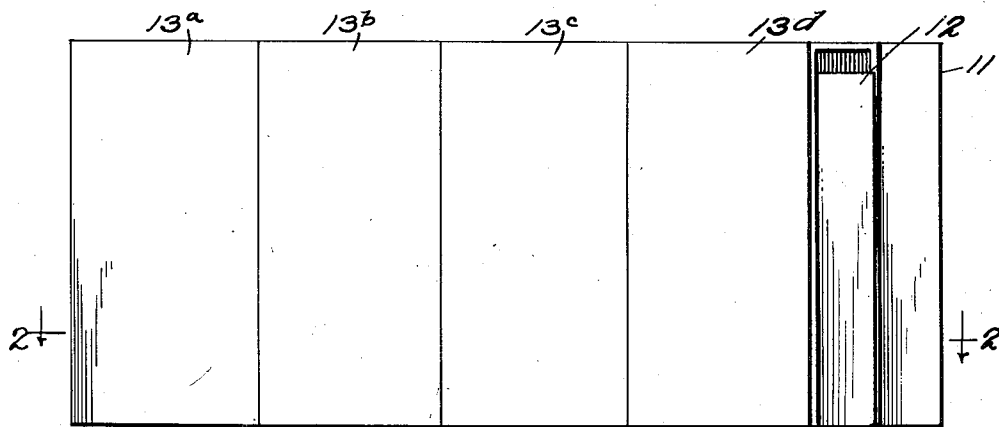
L. H. WITTNER

2,295,248

PREFABRICATED PLYWOOD PANEL UNIT

Filed Sept. 6, 1941

2 Sheets-Sheet 1



Inventor
Loren H. Wittner

H. F. Doyle
Attorney

Sept. 8, 1942.

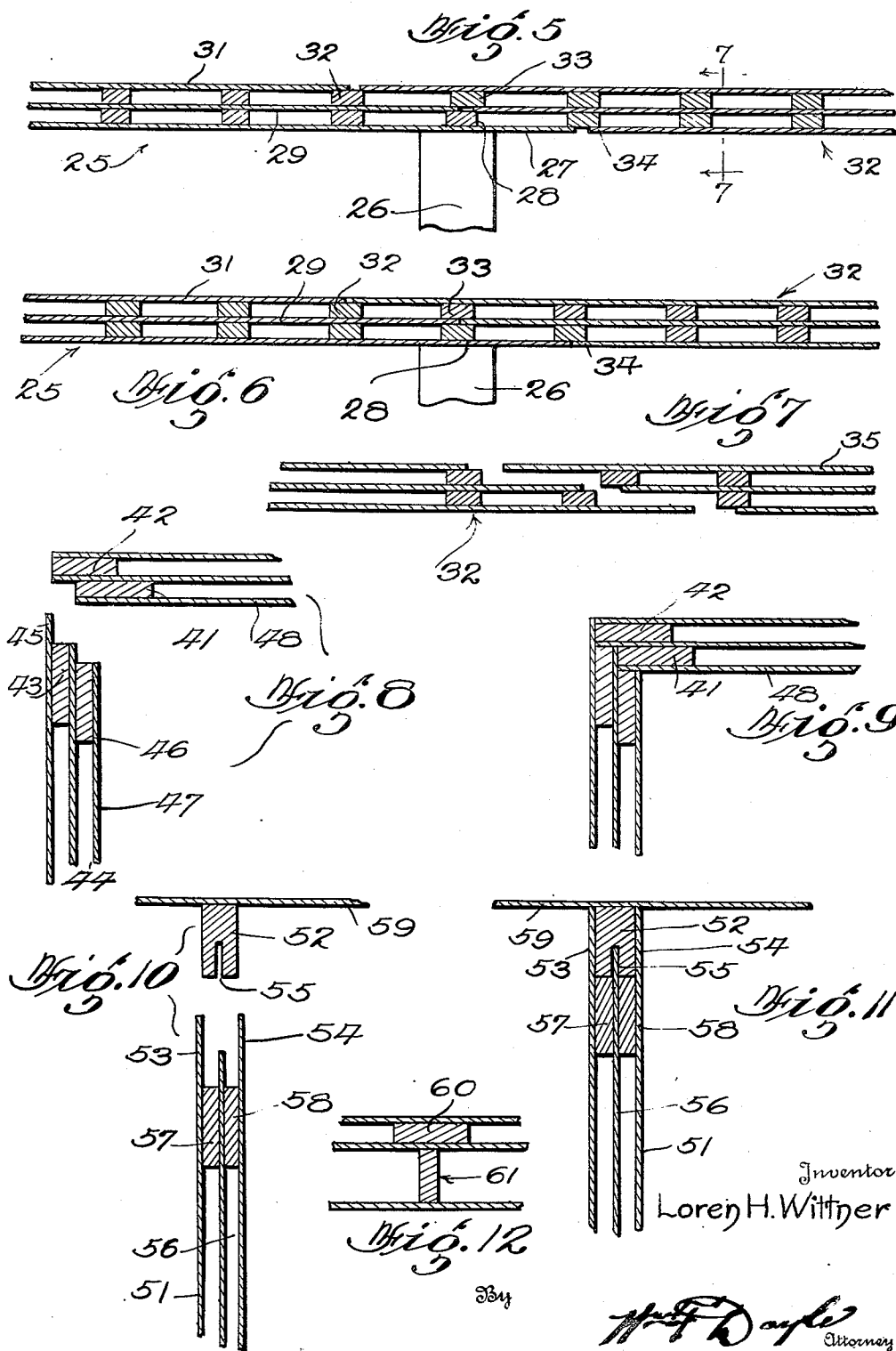
L. H. WITTNER

2,295,248

PREFABRICATED PLYWOOD PANEL UNIT

Filed Sept. 6, 1941

2 Sheets-Sheet 2



UNITED STATES PATENT OFFICE

2,295,248

PREFABRICATED PLYWOOD PANEL UNIT

Loren H. Wittner, Odenton, Md.

Application September 6, 1941, Serial No. 409,773

1 Claim. (Cl. 20—91)

(Granted under the act of March 3, 1883, as amended April 30, 1928; 370 O. G. 757)

The invention described herein, if patented may be manufactured and used by or for the Government for governmental purposes without the payment of any royalty thereon.

The present invention relates to a prefabricated construction panel, and more particularly to a novel and improved box frame type plywood panel unit. It is one of the principal objects of this invention to provide a new and improved design for a plywood building panel, utilizing a relatively small amount of material and arranged to provide a relatively thin wall structure of great rigidity.

A further object of the invention is to provide a multiple box frame panel arranged to be fabricated and united in the process of fabrication by adhesive means only, and to provide a novel mechanical design for such a panel whereby unusually large adhesive uniting surfaces are presented to each other.

A further object of the invention is to provide a new and improved panel joint whereby the adjoining panels in a building construction become, when joined, so interrelated as to provide a substantially integral construction throughout the entire floor or wall area into which the several panels are united.

A further object of the invention is to provide a novel panel joint whereby adjacent panels become so associated with each other as to provide a distribution of load through the entire floor or wall.

Another object of the invention is to provide a panel joint wherein relative flexing between adjacent panels at the point of junction is minimized, to the end that the load carried by any individual panel will be distributed throughout the adjacent panels.

A further object of the invention is to provide a multiple box frame panel comprising a plurality of plywood sheets, each spaced apart from and in face-to-face relationship with a similar plywood sheet, and united therewith by a framing member comprising a series of joists extending in one direction and joined at regular intervals by transverse struts.

Other objects will appear hereinafter.

It is recognized that in the present state of the art it is common practice to provide prefabricated wooden panel sections adapted to be joined with or interlocked with similar sections to form the walls, floors, ceilings or roofs of various types of buildings. As commonly used, these panels comprise relatively long and narrow units, often consisting of two sheets of plywood united along their edges by suitable joists or other frame members. In the construction of a building, it is common practice to unite the edges of such panels with splines, keys, or tongue and groove

connections, or to provide bolts and screws by which the panels may be joined.

In actual practice, such panels have been providing somewhat unsatisfactory in that the panels themselves do not possess sufficient rigidity of structural design so that they remain straight and true, and particularly for the reason that the joints, by which each panel is joined to the adjacent panel, do not provide a sufficiently intimate and integral connection between the panels to prevent relative movement. In this connection, it may be well pointed out that almost any type of connection between adjacent panels will, to a certain degree, at least, transmit forces and prevent movement in a direction perpendicular to the surface of the panel. However, it is also essential that the adjacent panels lie in exactly the same plane to provide a smooth and uninterrupted wall surface and the panel connections, at present commonly used in the art, fall in this particular, in that they permit a certain amount of buckling at the panel juncture or angular irregularity between the adjacent panels.

In the following disclosure, it will be apparent that these difficulties are overcome by the practice of the principles of this invention, by the provision of a multiple box frame having three or more plywood sheets, each spaced apart from the others by a frame member of comparatively thin, flat joists and struts; so that the entire unit will be comparatively thin and yet will have unusual rigidity.

In recently conducted tests of framing and plywood structures wherein all members were bound into an integral unit by uniting all of the contacting surfaces with water-resistant adhesives, it has been established that the deviation of a given type of panel under load was inversely proportional to the square of the number of box girders superimposed one on the other. Thus, by the utilization of the principles of this invention, a panel of standard rigidity may be obtained by the use of less material (thinner plywood sheets and smaller frame members) than heretofore regarded as practicable. It has been found that the utilization of three thin plywood sheets joined by two separating frames is of greater rigidity than the customary construction of two plywood sheets and a single frame, notwithstanding the fact that the former construction has been of materials of sufficiently smaller dimensions that the total amount of lumber utilized is less than in the last named construction.

In the present invention, the panels are constructed by uniting three sheets of plywood on the opposite sides of and between a pair of basic frames. The frames are customarily and preferably formed in a generally rectangular shape,

having a series of joists running in one direction and united by a multiplicity of cross-struts so that the framework, as an entirety, forms a grill-work of frame members extending in both directions to define a multiplicity of rectangular frame sections. In practice, the two frame members are offset from each other a distance equal to the dimension of one of the rectangular sections and the external plywood sheets are also offset a distance equivalent to the dimension of two sections so that when the panel is united with the corresponding edge of an adjacent panel, the plywood sheets of each panel can be adhesively secured to the frame members of the adjoining panel, and there will be sufficient overlapping in the panel juncture to insure absolute rigidity and to result in a construction wherein the panels cooperate to form a substantially integral wall.

It will be understood that since each individual plywood sheet is composed of three or more plies of wood with the grain of the individual plies running perpendicularly with respect to each other, these sheets are admirably adapted to resist forces in any direction. Even greater rigidity may be obtained, however, by placing one or more of the plywood sheets, preferably the median sheet, at an angle, so that the grain of the plywood will run diagonally across the panel. This construction increases the rigidity of the panels by offering increased resistance to forces acting in a diagonal direction across the panels, and, while not regarded as essential to the success of the present invention, possesses marked advantages.

Referring now more particularly to the drawings,

Fig. 1 is a front elevational view of a typical wall panel constructed in accordance with the principles of this invention.

Fig. 2 is a detail plan sectional view of the wall panel illustrated in Fig. 1 and taken substantially on the plane of the line 2—2 in Fig. 1.

Fig. 3 is an elevational view of one of the basic frames of the panel construction illustrating the joists extending in a direction transversely across the width of the panel; the preferred form for use on a wall panel.

Fig. 4 is an elevational view of the preferred type of basic frame for use in floor and roof panels and illustrates joists extending across the long dimension of the panel.

Fig. 5 is a sectional view illustrating the unassembled floor panel joint.

Fig. 6 is a sectional view similar to Fig. 5 illustrating the panel sections in assembled position.

Fig. 7 is a detail sectional view of an unassembled joint between adjacent sections of a floor panel and is taken substantially on the plane of the line 7—7 in Fig. 5.

Fig. 8 is a plan sectional view illustrating an unassembled corner construction.

Fig. 9 is a plan sectional view similar to Fig. 8 and showing the panels in completely assembled position.

Fig. 10 is a sectional elevational view of a ceiling sill and wall panel in unassembled relationship.

Fig. 11 is a sectional elevational view similar to Fig. 10, showing the parts in fully assembled position.

Fig. 12 is a sectional view of a modified type of floor panel.

As illustrated in the drawings, each panel section consists of an exterior plywood sheet 11, a

median or central plywood sheet 12, and an exterior plywood sheet 13. In small dimension panels, each of these sheets may be, if desired, a single sheet of plywood, but inasmuch as it is contemplated to provide panels having an overall dimension of 8 ft. x 16 ft. on centers, it is preferable to form each of the plywood sheets of a number of smaller pieces of plywood; for example, as illustrated in Fig. 1, the 8 ft. x 16 ft. area is composed of 4 sheets of plywood, 13—A, 13—B, 13—C and 13—D, each having dimensions of 4 ft. x 8 ft. and placed in parallel adjoining relationship with each other. The plywood sheets 11, 12 and 13 are spaced apart from each other by two identical basic frames such as the frames 14 and 15, and all of the contacting surfaces between the several sheets of plywood and the frames are securely united by waterproof adhesive.

Each of the frames 14 and 15 is composed of a pair of edge members 16 and 17 joined by a series of joists 18 extending completely across the frame and spaced apart from each other at regular intervals. The joists 18 are in turn united with each other by a multiplicity of cross-struts 19 which are arranged in rows so that the entire frame forms a grill-work of relatively small, square or rectangular sections. Certain modifications in the dimensions and structural details of the frame and plywood sheets are possible without sacrificing the advantages gained by the practice of the teachings of this disclosure, but it is at present considered preferable to form panels intended for use as wall panels of three sheets of plywood, each $\frac{3}{8}$ inch in thickness and spaced from its adjoining sheet by a framework made up of joists and studs $\frac{3}{4}$ inch in thickness and 2 inches in width, with the relatively wide 2-inch faces of the frame in adhesively secured relationship with the plywood sheets.

In the construction of a panel of 8 feet by 16 feet dimensions, a highly satisfactory arrangement is to provide 13 joists in each frame extending across the width of the frame and united with each other by five lines of cross-struts in addition to the edge members 16 and 17. This construction provides a basic frame made up of a multiplicity of square box elements, each 16 inches by 16 inches on centers.

In the case of a floor construction somewhat heavier basic frames are preferred and for this purpose the frame illustrated in Fig. 4 has been found most satisfactory. The floor frame illustrated in Fig. 4 differs from the wall frame illustrated in Fig. 3 in that, in the floor frame, the joists run across the long dimension of the panel; that is, there are seven longitudinally extending joists 21 extending between the edge members 22 and 23 at the opposite ends of the panel and the joists are united with each other by a multiplicity of transverse cross-struts 24 extending in lines across the width of the panel. The floor frames are ordinarily constructed of heavier material than the wall frames, the preferred construction being of lumber 2 inches in thickness and four inches in width. These frame members may, if desired, be set edgewise so that their narrow faces are in contact with the plywood panels, but it is preferred practice to place them in flat position so that their wider, flat faces contact the panels on both sides of the frame. This construction possesses marked advantages in that it decreases the thickness of the floor and also in that it provides greatly increased surfaces for the adhesive between the several elements of the panel.

As hereinbefore stated, it is one of the principal objects of the invention to provide a new and improved panel joint whereby the load imposed on any given panel in a floor structure, for example, is distributed throughout the entire floor structure. The manner in which this is accomplished is illustrated in Figs. 5 to 7.

With particular reference now to Fig. 5, which illustrates a typical floor section center bearing joint, it will be seen that the panel 25, which extends from an outside foundation, not shown, to the center foundation wall 26, is so positioned that the lower plywood sheet 27 extends somewhat beyond the foundation 26 in order that the edge frame member 28 of the lower basic frame will lie directly on the center of the foundation. The median plywood sheet 29 is arranged to extend to the exact center of the edge frame member 28 but the upper basic frame member is offset so that its edge member 31 lies directly over the first of the cross-struts 32 on the lower frame, that is, the upper frame is offset from the lower frame a distance corresponding to the dimension of one of the rectangular sections of the frame grill for reasons that will appear shortly.

The upper sheet of plywood is positioned to extend only to the center of the edge piece 32. Thus, the entire unit comprises a staggered edge arranged to overlap the central foundation 26. The cooperating panel 32 is of identical construction with the panel 25 but is inverted so that the upper frame 33 extends to the center of the foundation 26 and the lower frame 34 is offset away from the foundation wall. The plywood sheets are also offset in the same manner so that when the sections are joined, each of the plywood sheets will come into the square abutting relationship with the adjoining sheet of plywood. The edge elements of frame members 28 and 33 will be positioned directly above each other so that each may be adhesively united with the central or median plywood sheet of the offset section and the offset edge frame members 31 and 34 will each be adhesively united with the overhanging edges of plywood extending beyond the frames of the respective panels.

In uniting the adjacent panels, the entire contacting surfaces are coated with a waterproof adhesive and the panels are held in face-to-face relationship until the adhesive has thoroughly set so that, when the joint is thoroughly completed, the two panels coact with each other to comprise a single unitary floor structure and there is no difference between the construction of the floor at the point of juncture and the construction at any other point throughout the area of any of the panels.

The joint illustrated in Fig. 7 occurs at the ends of two of the panel units; but it should be understood, of course, that in the case of floor panels identical joints are provided between each of the long side edges of contiguous panels. This is illustrated in Fig. 7, where the relationship between the panel 32 with the adjoining panel 35 is shown to be identical with the joint heretofore described as between the panels 25 and 32.

A typical corner joint for wall panel is illustrated in Fig. 8. In this case the edge frame joist 41 is offset from the joist 42 only sufficiently to be set back a distance equivalent to the thickness of the frame 43 plus the thickness of the median panel 44, so that the two panels may be dove-

tailed into exact position as illustrated in Fig. 9. Similarly, the exterior sheet of plywood 45 extends beyond the frame joist 43 a distance equivalent to the thickness of the frame and joist 42 and the median and exterior plywood sheets, and the joist 46 and panel 47 are offset a distance equivalent to the thickness of the joist 41 and interior sheet of plywood 48. This construction provides a corner joint of extreme rigidity and the staggered relationship of the panel edges provides a comparatively large surface for the adhesive used to unite the panels.

A wall panel 51 is preferably united to the floor or ceiling panels by means of a sill 52 first adhesively secured to the wall or ceiling, as the case may be, and then fitted into the edge of the wall panel. The preferred form of this sill is illustrated in Fig. 10 where the sill 52 is of a width equivalent to the distance between the interior surfaces of the plywood sheets 53 and 54 and is provided with a central groove 55 arranged to receive the edge of the median plywood sheet 56. In this construction, the edge members 57 and 58 of the frame are each offset sufficiently so that the exterior plywood sheets 53 and 54 may come into contact with the surface 59 of the ceiling as illustrated in Fig. 11.

As hereinbefore stated, the joists are preferably, though not necessarily, placed in flat position with their wide faces secured to the plywood sheets. It has also been found satisfactory to form a panel with one of the frames in flat position and arranged to cooperate with a second frame in edgewise position, as shown in Fig. 12, so that the adjoining joists 60 and 61 will cooperate to form, in effect, a T shaped joist of great rigidity.

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

In a construction panel, in combination, a multiple box-girder plywood panel consisting of a center plywood sheet and two surface plywood sheets, each of said surface sheets being spaced apart from the center sheet by one of a pair of frame members, each of said pair of frame members consisting of a multiplicity of rectangular joists spaced from each other at regular intervals; each of said pair of frame members being adhesively united to and in contacting relationship with the center plywood sheet and one of the surface plywood sheets; the structure being characterized by the edge construction wherein the pair of frame members are offset from each other a distance equal to the spacing between the individual joists of the frame, so that the edge joist of one frame will overlies and register with the second joist of the other frame, and the plywood sheets are located in offset position with respect to said frame members and to each other so that one of the surface sheets has its edge positioned at the center of the edge joist of one of the frame members, the center plywood sheet has its edge positioned at the center of the edge joist of the other frame member, and the other surface plywood sheet extends beyond the edge of the center of the edge joist of the frame a distance equal to the spacing between the joists, to provide a staggered offset panel edge adapted to fit and be adhesively united with an identical inverted panel edge, to form a panel juncture.

LOREN H. WITTNER.