Dec. 22, 1942. W. C. BAILEY 2,306,151

SCARF JOINT FOR PANELS AND METHOD OF MAKING SAME

Filed Aug. 25, 1939

Fig. 1

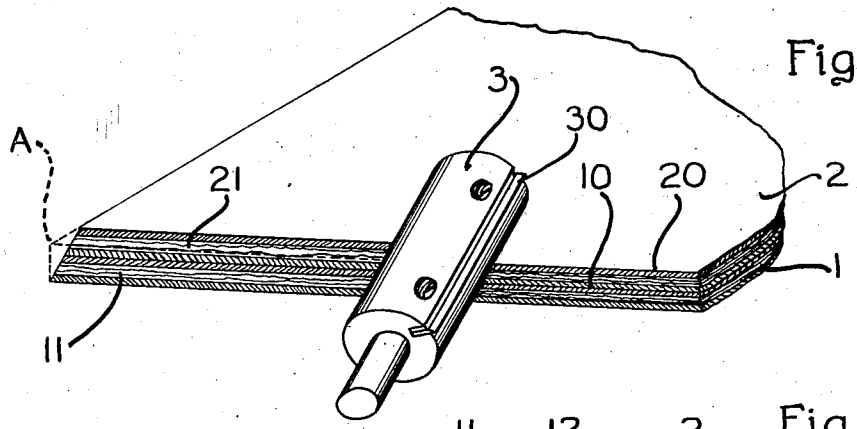


Fig. 2

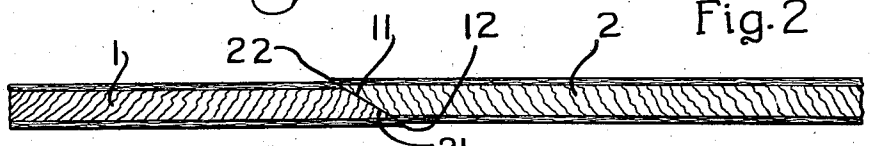


Fig. 3

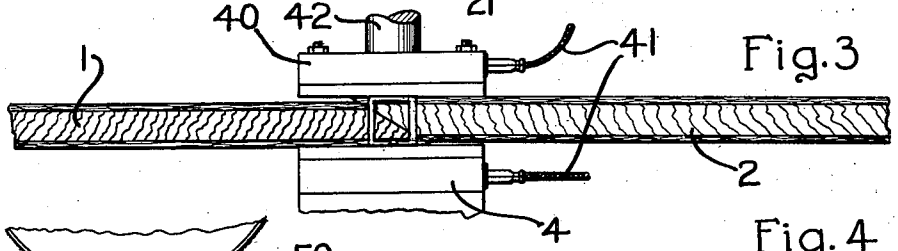
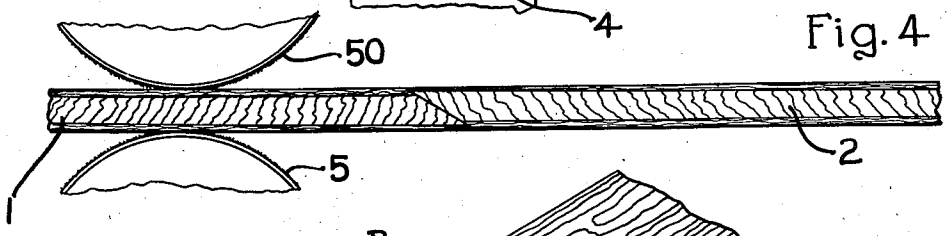


Fig. 4



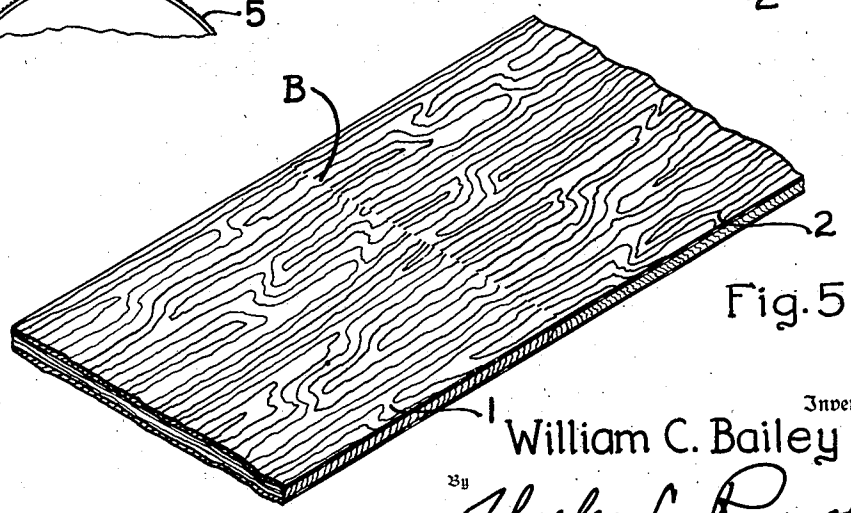


Fig. 5

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SCARF JOINT FOR PANELS AND METHOD OF MAKING THE SAME

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7 Claims. (Cl. 144—309)

Most plywood panels are made up in the standard four foot by eight foot size. In consequence, all equipment of the plywood mill is gauged to make panels of that size. The logs are cut to about this length; the veneer rolls, the veneering knives, the dryers, the presses and the like, are all arranged to accommodate this size. Smaller sizes can, of course, be made by cutting down the four foot by eight foot panels, but if larger sizes are desired, it becomes most difficult to make them. Some few mills are set up to make panels up to twelve feet in length, but these are only a few, for it can be appreciated that since the greater percentage by far of the demand is for four by eight panels, or less, it is scarcely economical to provide and maintain equipment capable of making larger sizes when the demand therefor is relatively so slight. By the same token, the cost of the larger panels is excessive as compared with the cost of the four by eight panels, simply because the added cost of providing and maintaining the equipment capable of making the larger panels must be apportioned over the very small market for the larger panels, or else, must be absorbed in the cost of the four foot by eight foot panels, which are competitive articles. In other words, if the mill attempts to absorb the cost of twelve foot panels in the cost of the eight foot panels, by so much it is handicapped relative to competitors that, because they make nothing larger than the eight foot panels, do not have to absorb the cost of the twelve foot panels.

There is a certain demand for such extra-size panels, and this demand would naturally increase if it were possible to supply such extra-size panels at reasonable cost, more or less comparable to the cost of the eight foot panels.

It has been proposed to make extra-size panels by completing one end first, and then completing the second end. This involves the initial difficulty that the logs must be cut to excessive lengths, and knives must be capable of removing veneer of excessive lengths, and it must all be dried and handled up to the point of laying up and pressing by special equipment, but it has been attempted to avoid installing presses of a size adequate to press the extra-length panels in one operation by employing presses intended for shorter lengths, and pressing first the one end and then the other end. This operation, however, is a makeshift at best, and is not very satisfactory, since it occasions extreme difficulty in handling the panel properly, in shifting it, in bringing it into proper registry, and in avoiding overpressing or underpressing some part of the panel, with consequent separation if this does occur. Especially greater is this difficulty of so doing when using an adhesive which sets under heat and pressure, since the amount and degree of heat and of pressure is usually critical in such adhesives, and it is impossible, where the panel sticks out of the press at the first pressing and where it enters the press at the second pressing, to avoid overheating or underheating, or excessive pressure.

It has also been proposed to join two such panels by scarfing their edges, and joining the scarfed edges with an adhesive, but this has never proven practical commercially. It has been considered physically possible, if the edges are scarfed by hand, but this is economically impossible. It has been considered impossible to obtain a satisfactory degree of accuracy if cutterhead machines are used to scarf the edges, and such machine-made joints have never been satisfactory. The edges could not be made to adhere sufficiently strongly and the joints would separate. This was attributed to the roughness or inaccuracy of the joint when machine-made, and it was considered that the only practicable way of effecting such scarf-joints which would hold was to make them by skilled workmen, of the grade of cabinet makers. This, of course, was entirely impracticable economically, or for quantity production.

I have discovered that the weakness of such machine-made scarf-joints is not at all due to inaccuracy in making the joints, but is due rather to failure to obtain and to maintain proper pressure throughout the whole area of the joint during the setting of the adhesive, and I have discovered further how such distribution of pressure and production of adequate pressure over the entire joint area may be achieved, as hereinafter disclosed.

The present invention, then, comprises the novel step in the process of making scarf-jointed panels by securing adequate pressure over the entire width of the joint, and the novel process of making scarf-jointed panels which is possible of achievement by the inclusion of such a step, as well as the finished joint and jointed panel fabricated by such process.

In the discussion so far, emphasis has been placed upon plywood panels, and they are peculiarly adaptable to be joined by such a process. The process is not restricted to plywood panels alone, however, and solid panels may be scarf-jointed in the same way, or panels of material

other than wood, for instance, a so-called hard board, of pressed composition material, or of material pressed and caused to cohere by a binder which sets under heat and pressure, may be thus joined. Indeed, panels of any suitable material capable of being scarfed at the edges and capable of being joined by an adhesive, and which possess some flexibility or elasticity under compression, may be thus joined.

In the accompanying drawing I have shown in diagrammatic fashion the successive steps of the process, and the final product.

Figure 1 is a diagrammatic illustration, in perspective, of the scarfing step, which, except for the laying up one panel upon another, is the first step in the process.

Figure 2 is an edge view of a subsequent step in the process, following the application of adhesive.

Figure 3 is an edge view, similar to Figure 2, of a subsequent step in the process—the pressing step.

Figure 4 is an edge view of the optional final step, namely the surface-finishing after pressing.

Figure 5 is a perspective view of the final product.

The process will be described in conjunction with plywood panels which are joined end for end, although it is to be remembered that it is applicable to various types of panels, as indicated above, and that it is applicable, also, to the joining of panels edge to edge as distinguished from end to end. Moreover, the invention contemplates the joining of plywood panels of approximately equal thickness the core portions of which, whether composed of only a single ply or a plurality of plies, are of approximately equal thickness, and the surface plies of which also are of approximately equal thickness.

In carrying out the process it is convenient to pile two panels one upon the other, so that their ends to be joined (which are hereafter termed edges) may be scarfed simultaneously. As shown herein the panel **2** is piled upon the panel **1**, with their respective edges **10** and **20** substantially in alignment or in registry. The edge **20** might be stepped back slightly from the edge **10**, to avoid waste of material, but this is a minor consideration, and normally in order to secure proper alignment suitable positioning means for the edges **10** and **20** are provided (such, for example, as disclosed in the drawings and described in the paragraph beginning at line 26, second column of page 1 of my patent on the machine, No. 2,252,112, issued August 12, 1941) to exactly align them with each other, and if the two panels are square their edges at right angles to the edges **10** and **20** are likewise aligned or parallel. The piling operation is largely a matter of convenience and optional, and the panels may be scarfed one by one. Assuming that they are piled as shown, the next step is to effect relative transverse movement between the panels and a cutterhead **3**, provided with knives **30** and disposed at a scarfing angle to the edges **10** and **20**. It is immaterial whether the panels are moved or the cutter-heads, though, of course, the movement should be precisely parallel to the edges **10** and **20**. In the scarfing machine shown in my above-mentioned patent this result automatically follows. In Figure 1 the material, indicated by the dotted lines at A, at the left, has been removed, and the material at the right of the cutterhead is still to be removed. By this step the two edges **10** and **20** are scarfed to identically the same angle, so that one of the surface plies of each panel edge portion is shorter than the other and the longer surface ply is formed with a feather edge **12** and **22**, which I designate a surface feather as distinguished from a tongue along the central portion of a joining edge.

The next step is the application of the adhesive to at least one of the now scarfed edges **11** and **21**; it is sometimes preferred to place the adhesive on only one of such edges, or it may be placed at will on both such edges. If it is to be placed on both the edges it is convenient, though not by any means essential, to place the adhesive while the edges are in the positions they occupy at the left in Figure 1, for in this manner there is the least slopping over of adhesive on the surfaces of the panel. The adhesive can be applied simultaneously to the edges **11** and **21**. Usually and preferably, the adhesive is one that sets under heat and pressure, such as a synthetic resin binder.

With the adhesive applied, and if necessary air-dried to the desired degree, the uppermost panel **2** is reversed, end for end, to bring its edge **21** into overlapping relation to the edge **11**, that is, as shown, the subsurface side of each feather **12** or **20** is in contiguous engagement with the other joining edge, while the surface side of each feather is completely exposed. However, it is not enough merely to overlap them so that the surfaces of the panel are flush. Instead, and this is an essential part of the process, and the secret of its success, the edges must be overlapped somewhat in excess of the width of the joint, so that the surface side of each feather edge, as indicated at **12** and at **22**, lies above the adjacent surface of the other panel. Where "feather edge" is referred to, it is not to be implied that the edge is excessively irregular or serrated, or even that it necessarily comes to an acute angle so long as the overlapping feather will be pressed firmly against the outer surface of the other panel being joined, while the pressure will be concentrated primarily on the panel edges inwardly of the feathers, because the body of the material there is thicker. Thus the feather edge should be narrow as compared to the joint and may be tapered or otherwise formed or located with respect to the panel surface so that when the press platens first clamp the opposite sides of the joint in closing there will be a gap between the feather and either the adjacent face of the other panel, as shown in Figures 2 and 3, or the platen, or both. As the pressure increases on the joint proper such gap will be closed progressively until the feather is pressed tightly against such panel surface. Steps are taken to hold the panels in this overlapped relation, and usually this can best be accomplished by overlapping them while they are in operative relation to press plates, or by employing any suitable auxiliary means such as clamps, interlocking joint parts, or temporary tacking or taping to hold them thus overlapped. Note, for example, the clinched staple interconnecting the scarfed panel edges in Fig. 3. Any such tack, nail, or staple is placed close enough to the end of the joint so that after the edges have been joined, but before the sanding operation, the composite panel may be edged to remove the strip in which such temporary holding element is embedded.

The pressing operation ensues, with the joints thus overlapping. In Figure 3 is shown a lower press plate **4** and an upper press plate **40**, each suitably heated, as by electricity through the electric leads **41**, and pressed together by a suitable force applied to the stem **42** of the upper press plates **40**. The excessive overlap in Figures 2 and 3 has been shown somewhat exaggeratedly, in order

to make clear the principle, which is that during the pressing operation and while the adhesive is setting, the panels are held overlapped somewhat in excess of the width of the scarfed edge, so that the feather edge of each panel is raised above the adjoining surface of the other panel. The effect of this is to relieve the panel surfaces which are adjacent or outside of the joint area, of substantially all the pressure, and to concentrate substantially all the pressure of the press plates 4 and 40 upon the joint itself, as may be seen in Figure 3. With the joint thus clamped between the two press plates, and with the pressure thereof localized along the joint, there is obtained adequate pressure to insure firm adhesion along the entire length of the joint. Because of the initial space between the feather and panel surface, the feather will not be subjected to as great pressure as the scarfed edges proper, but because of the added thickness of the feathers more pressure will be exerted on them than on the adjacent panel portions.

For some purposes, or with some presses, it may be found that the slight raising of the feather edges is not objectionable in the finished panel, or is so slight as to be not particularly noticeable, or the feather edges may be so deformably pressed down by the pressure, that their projection is not particularly noticeable, which permanent compression, of course, necessarily involves crushing the material in the joint somewhat. If such is the case, the panel is finished when the adhesive has been set within the press. However, for most purposes it will be found desirable to smooth off the surface by removing the step caused by the excessive overlap. This may be conveniently done, with the composite panel in planar, undeflected position, by any suitable means, as for instance, by passing the panel through a sander represented by the sander drums **5** and **50**, the panel moving from left to right as shown in Figure 4. In fact such panels are so stiff that they cannot be appreciably deflected without being broken, and great force would be required for that. It will be observed here that in removing the feather edge **22** the top ply of the panel **2**, adjacent the joint, is made somewhat thinner than the adjacent top ply of the panel **1**, and the lower ply of this latter panel is made somewhat thinner than the lower ply of the panel **2**. However, the thinned portion of each such ply is sufficiently thick that the panel is undamaged, and the joint as a whole is, of course, finally at least as thick as the main body of the panel.

The final result is shown in Figure 5. The joint is indicated at B, but if reasonable care is taken to join two panels which do not differ excessively in the type or size of graining the joint at B is scarcely noticeable. In any event it is noticeable primarily by the break in the grain, and not by any lines which appear across the face of the finished panel. Viewed from the edge it is practically imposssible to discover the scarf-joints, although their locations may be ascertained by the partially offset or stepped relationship of the corresponding panel laminations, or core layers, occasioned by the excessive overlapping of the panel edges in the fabrication of the joint. The neutral axes of the joined edges, prior to the dressing operation lying midway between their opposite surfaces, will be offset in a direction normal to the panel surfaces through a distance a small fraction of a panel thickness. Such stepped arrangement of the cores, and corresponding offset of the neutral axes, is not discernable by the appearance of the panel surface, as shown in Figure 5.

The portion of each feather projecting beyond the chamfer of the other panel and overlapping the adjoining portion of its original outer surface is pressed down onto such surface by the joining operation so firmly that the junction there also is practically indistinguishable in the panel edge. When the joint is completed before being dressed, the outer surfaces of each panel remain exposed except for the small strips at the joint, one on each side of the composite panel, covered by the overlapping feathers, whereas the sub-surface or cut side of each feather is completely covered by engagement with the other panel. After being dressed, so that the panel faces on opposite sides of the joint line are coplanar, as shown in Figures 4 and 5, both surfaces of the joint are still formed by the face plies, since the offset of the neutral axes of the panels at the joint is much less than the thickness of a face ply. Only a fraction of the thickness of the overlapping feathers, progressively decreasing away from the joint, is removed in the final surfacing operation, their sub-surface sides and the portions of the outer panel surfaces which they cover being depressed below the adjacent uncovered portions of the outer panel surfaces. It is obvious that such panels may be made of any length desired and from panels of normal, commercial sizes, for instance, two eight foot panels may be joined to make a panel sixteen feet in length, or approximately that length, taking into consideration that some material is removed and the panels are somewhat shortened in making the joints. Likewise if great width is desired panels may be joined edge for edge in identically the same manner.

It has been found in practice that such joints, in plywood and in hard board, are fully as strong, indeed, stronger than the panels themselves, and if a panel with such a joint is held in a vise close to the joint and then bent until it fails, it will fail in the panel itself and not at the joint.

What I claim as my invention is:

1. A process of scarf-jointing panels which comprises similarly scarfing the edges to be joined including forming a tapered surface feather along each edge, applying one scarfed edge to the other, with adhesive between them, in such manner that the surface side of the scarfed edge of each panel is exposed and the sub-surface side of each scarfed edge is in contiguous engagement with the other scarfed edge, and each tapered feather extends slightly past the juncture of the surface and of the scarf of the other panel, and overlies but is spaced from that surface of the other panel, applying pressure, during setting of the adhesive, against the scarfed edges and feathers of the panels while the panels are maintained in position with the tapered feathers of the panels each slightly overlying the surface of the other panel, and thereby pressing them into contiguous engagement with such surfaces and bonding them thereto, and while the panels and joint are maintained in substantially undeflected relationship removing material left upstanding above the general surfaces of the jointed panels, until all parts of each surface are in substantially a common plane.

2. A process of scarf-jointing laminated panels, such as plywood, which comprises similarly bevel scarf cutting each of the edges to be joined

including forming a tapered surface feather along each edge, whereby the width of each scarf and its angle relative to each surface of its panel, as well as the taper of each surface feather, is the same in each such panel, applying one scarfed edge to the other, with adhesive therebetween, in such manner that the surface side of the scarfed edge of each panel is exposed and the cut side of each scarfed edge is in contiguous engagement with the other scarfed edge, and each feather is of a width a small fraction of the total width of the scarfed edge so that it extends slightly past the juncture of the scarf and the surface of the other panel, and overlies but is spaced from that surface of the other panel, and the corresponding laminations in the two panels are disposed partly in registry, though slightly misaligned, the composite thickness of the engaged scarfed edges being thus slightly greater than the thickness of any adjacent part of the two panels, applying pressure, during setting of the adhesive, against the surface sides of the scarfed edges and feathers of the panels while such feathers are maintained in position each slightly overlying the surface of the other panel, and thereby progressively pressing them into contiguous engagement with such surfaces and bonding them thereto, and removing the excess thickness from the panels in the vicinity of the joint down to surfaces, in undeflected position of the joint, substantially in the same plane on each side with the faces of the joined panels, but less than the entire thickness of the face lamination of either panel.

3. A scarf joint of plywood panel edges, said panels being of generally similar thickness and each composed of at least three plies, including a core ply and surface plies, the entire meeting edges of both panels being scarfed complementally throughout the joint, the core ply of each panel being misaligned and stepped with respect to the core ply of the other panel, part of the core ply of each panel overlying part of the adjacent surface ply of the other panel along the joint for a width which is a small fraction of the total width of the joint, and the outer face of each surface ply merging substantially without trace into the face of the surface ply on the same side of the adjoined panel.

4. A scarf joint of plywood panel edges, said panels being of generally similar thickness and each composed of at least three plies, including a core ply and surface plies, the entire meeting edges of both panels being scarfed complementally throughout the joint, said core plies being in stepped relation and an unscarfed portion of one surface ply of each of the adjoined panel edges somewhat thinner at the region of the joint than the adjacent unscarfed portion of the surface ply on the same side of the other panel, and the outer face of each surface ply merging substantially without trace into the face of the surface ply on the same side of the adjoined panel.

5. A process of scarf-jointing panels, which comprises scarfing the joining edge of a panel including forming a surface feather along the joining edge, such feather being of a width a small fraction of the total width of such scarf, applying the sub-surface side of the scarfed joining edge in contiguous engagement with the other joining panel edge, with adhesive therebetween, the surface side of such scarfed edge projecting above the general corresponding surface of such other panel, to make the joint thus slightly thicker than any adjacent part of the two panels, with the sub-surface side of the surface feather overlying the adjacent outer surface of the other panel, and, during setting of the adhesive and while restraining the panels from relative movement transversely of the joint, pressing the thickened joint over its entire width, including the entire width of the feather, and thereby pressing such feather against the portion of the outer panel surface which it overlies and bonding it thereto, such pressure being concentrated to the greatest extent on the thickened joint portion of the scarfed edge other than the feather, to a lesser extent on the feather, and to the least extent on the panel portions adjacent the joint.

6. A process of scarf-jointing panels which comprises similarly scarf cutting two panel edges to be joined and thereby forming on each edge a tapered surface feather, applying the cut side of each scarfed edge in contiguous engagement with the similarly scarfed edge of the other panel, with adhesive therebetween, and with each feather extending past the juncture of the surface and of the scarf of the other panel, to dispose its sub-surface side overlying and spaced from the adjacent portion of the outer surface of the latter panel, and its surface side exposed, and applying pressure, during setting of the adhesive, against the surface sides of the scarfed edges and tapered feathers of the panels while such feathers are maintained in position each overlying the surface of the other panel, and thereby pressing each feather against the portion of the surface which it overlies and bonding it thereto.

7. A scarf joint between plywood panels of approximately equal thickness back from the joint, said panels each being composed of a pair of surface plies and an intermediate core portion, the core portions of said panels being of approximately equal thickness and corresponding surface plies of said panels being of approximately equal thickness back from the joint, the meeting edges of said panels being scarfed complementally over the entire width and length of the joint, the glue lines between the surface plies and the core portion of each panel being disalined transversely of the joint from the glue lines between the surface plies and the core portion of the other panel, and part of the core portion of each panel being alined transversely of the joint with part of the shorter surface ply of the other panel, the outer surfaces of corresponding surface plies of the panels merging substantially without trace into each other at the joint.

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