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METHOD OF AND MEANS FOR MAKING AND APPLYING CORRUGATED WOOD
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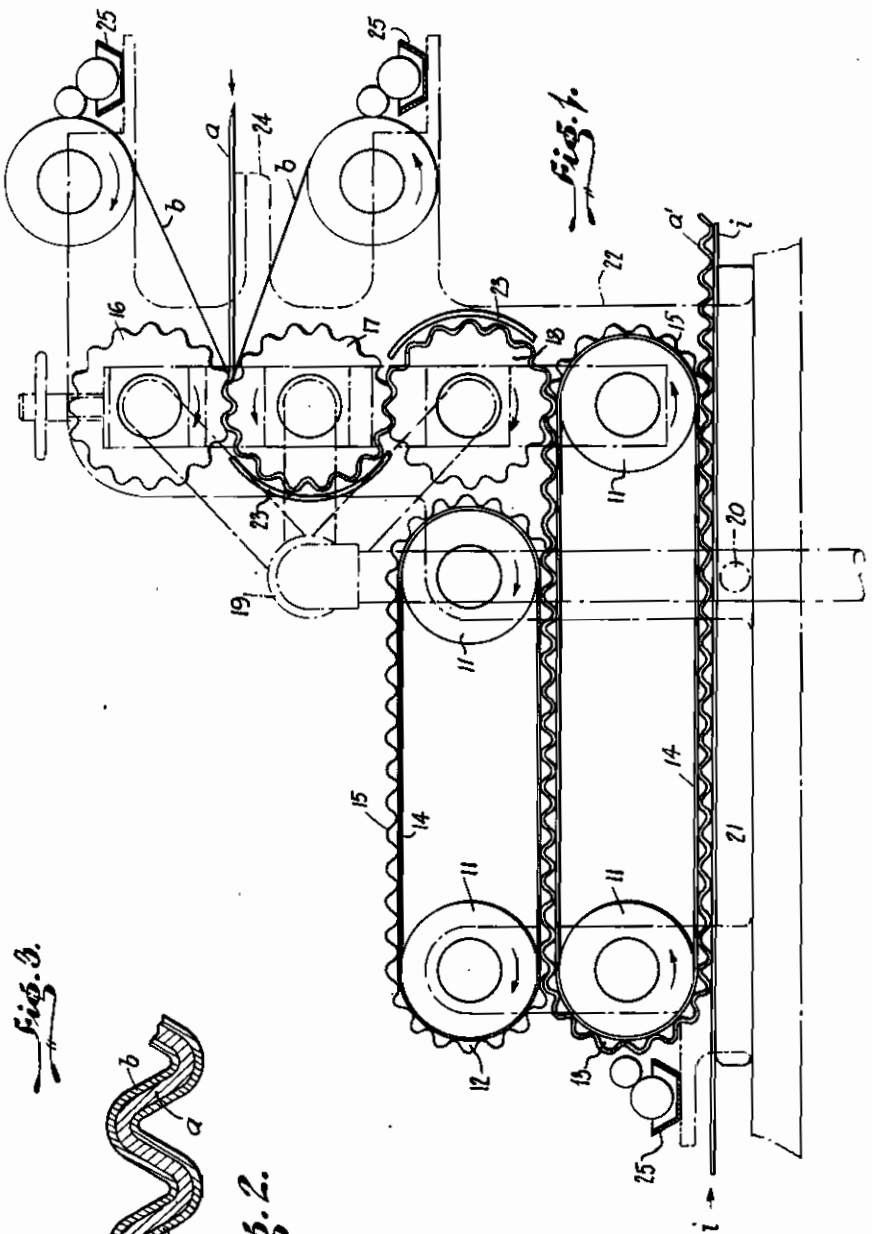

Fig. 1.

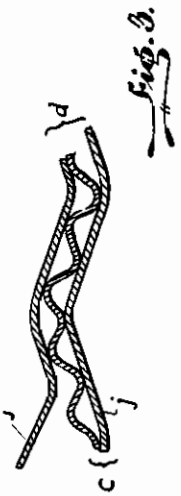

Fig. 3.

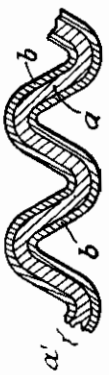

Fig. 2.

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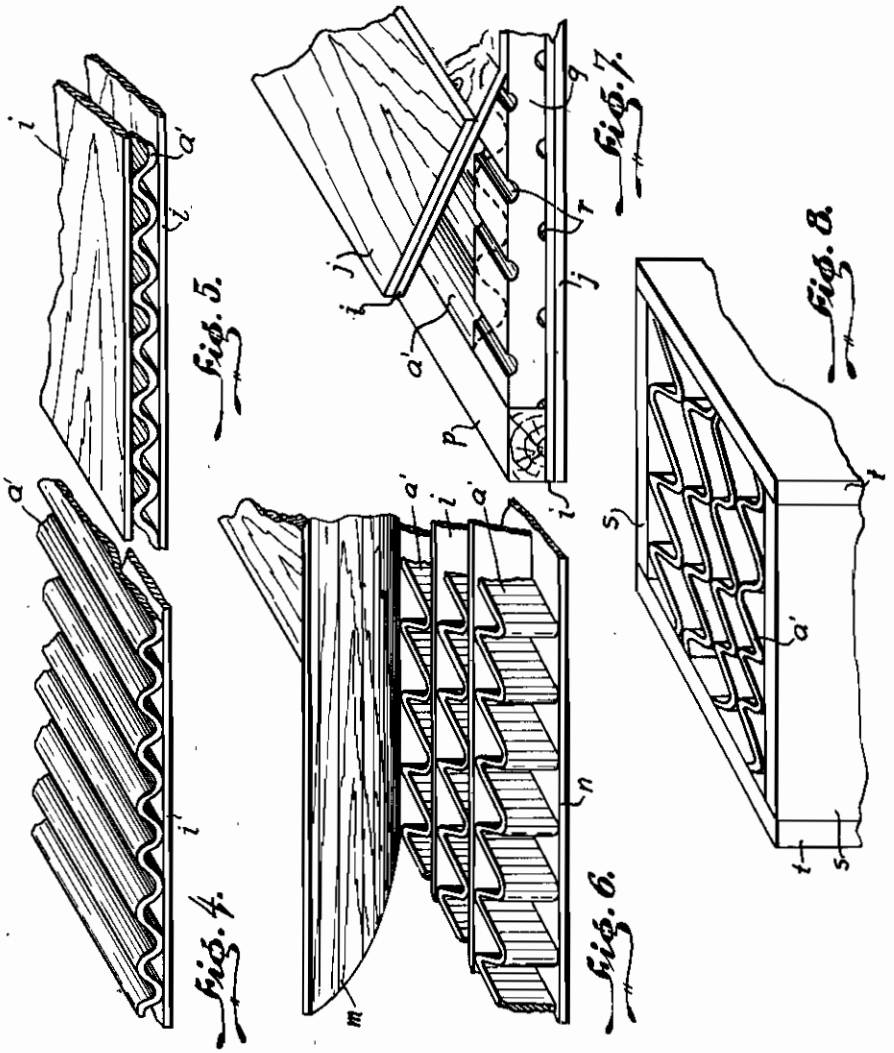

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ALIEN PROPERTY CUSTODIAN

METHOD OF AND MEANS FOR MAKING AND APPLYING CORRUGATED WOOD

Friedrich Wilhelm Franke, Leipzig, Germany; vested in the Alien Property Custodian

Application filed June 14, 1941

This invention concerns the method of and means for corrugating wood and of applying corrugated wood, for instance in corrugated ply wood, or for and in novel articles and materials described and claimed in my parent application Serial No. 185,492 of January 18th, 1938, entitled "Materials Comprising Corrugated Wood and Method of Making Same" and hereinafter shortly reviewed. The instant patent matter is divided as a continuation in part out of parent application Serial No. 185,492.

The corrugated wood may be defined as a crimped or waved sheet of ply of wood, or as wooden boards placed into folds, flutes, pleats or the like. The term corrugated ply wood has been applied in analogy to corrugated cardboard, so that the corrugated ply wood may be defined as corrugated wood assembled on one or both sides with one or more layers of sheet material.

For difficulties inherent to wood, corrugated wood and material assembled therefrom are not commercially available. Processes are known, which pass wood through a corrugating apparatus. But it is not the object of such processes to produce a predeterminedly corrugated wood. Their object is rather to "fracture" the sheets of wood in order to loosen the fibrous structure and to render them pliable and flexible, so that they may be curved and bent when used, for instance when applied as a veneer. Exhaustive experiments concerning the corrugation of sheets of wood led up to the discovery and invention concerned herein. When practices commonly used for corrugating other materials were applied, invariably the resulting corrugated sheets of wood were found to be unstable and otherwise unsatisfactory, because sooner or later they warp or otherwise lose the intended shape; and they crack, splice and splinter. Furthermore the resultant corrugated boards were found to be lacking in strength, apparently because the fibrous structure had been loosened and weakened. These shortcomings became more particularly evident, when the corrugated product was cut, e. g. sawed; as a matter of fact a clean saw-cut was found to be practically impossible.

It is the general object of this invention to overcome these disadvantages, and devise a method and means for commercially producing a serviceable and durable corrugated wood.

According to other objects of the invention the corrugated wood is to be incorporated in suitable structural shapes or profiles, such as plywood.

Particular objects of this invention are: To provide a wooden material which will not be destroyed nor harmed by the corrugating operation; to protect and retain the ply or sheet by a film or covering; to associate the film or covering intimately with the ply; to coordinate such association with the corrugating of the ply in order to avoid stress and strain; to provide apparatus timing such operation and for duly setting the corrugated wood during fabrication; to render the fabrication continuous; to coordinate the fabrication with an incorporation of the corrugated wood in a structural material; to impregnate the wood before or after corrugation with binders and infiltrations otherwise enhancing the characteristic of the wood; and to assemble the corrugated wood into predeterminedly resilient, flexible or rigid material.

Further objects of this invention will be learned from the following description thereof, which dwells upon specific examples, such specific examples being however shown and described for purposes of illustration only, and not in limitation of the invention.

In order to prevent the fibrous structure of the wood from being unduly damaged by the corrugating process, I start with a freshly stripped web of wood, i. e. a foil of green wood, or thin web of wood which has been rendered pliable like freshly stripped wood by suitable treatment such as steaming or soaking.

Such green or specially conditioned sheeting of wood will hereinafter be defined as a pliable ply of wood, such ply being flexible in its extent normal to the grain which is substantially the direction of corrugating, i. e. the corrugations are substantially in line with the grain.

If so desired a web may be used which is impregnated with synthetic resins, or other plastics.

A protective film is provided upon one or both sides, i. e. the top and the bottom of the foil or ply. This protective covering may be a thin layer, foil or film of paper, fabric, metal or plastic or synthetic material. As an adhesive between the web and the protective covering a suitable glue may be used, preferably a glue containing silicate. Sodium-potassium silicate mixed with glucose, carbonate of lime and a fatty oil rendered soluble in water by sulphonating have been found to be particularly suitable for such purpose. The covered web may be further treated with synthetic resin or the like.

Aside from binding and retaining the wood, the covering of ply may also serve for physical protection and as a seal.

As or when the covering and the web are or

have been thus assembled they are passed through a corrugating process,—the corrugations extending substantially in the direction of the grain of the wood. For instance the covering and web are assembled, and are passed and shaped and thermoset between fluting rollers in one and the same apparatus.

Heat is applied to the assembled and corrugated material, for instance by heating the tools corrugating the assembled sheets. Thus there may be a continuity of operation, in which the gluing proceeds the assembling of the cover and wood sheets and the assembled parts are corrugated before and during the setting of the adhesive and heat is applied.

If flat sheets, e. g. of wood or plywood are to be applid to the top or the bottom or both of the corrugated wood, such a step may be added to the continuity of operations just mentioned, the apices of the corrugated wood being attached to the flat material; e. g. an adhesive is applied to the apices and the parts are set and secured upon each other while passing through or over heated surfaces.

The corrugated foil which is thus assembled with flat sheeting, represents a corrugated plywood, to which preference may be given in many instances over the much heavier plywood of the old art.

But if the grain of corrugated wood and of a flat ply thus assembled run in the same direction, i. e. in the direction of the corrugations of the corrugated wood, the assembled material is still flexible in one direction. After it has been curved by bending in such direction, another flat sheet may be applied to the exposed side of the corrugated wood, whereupon the material becomes stiff and set in the curved formation and may serve as a curved wall, for instance for a barrel for fruit and the like. When, contrary to the arrangement just described, the grain of the flat covering plate extends at right angle to the grain and corrugations of the corrugated wood, the resultant corrugated plywood is elastic but not bendable.

Aside from the advantage of greater resiliency and of less weight over the ordinary plywood, the corrugated plywood also excels in heat and sound insulating properties, and the hollow corrugations may be filled with a suitable insulating material, e. g. cork, or with other materials for other purposes such as reinforcement, if so desired.

As compared with corrugated cardboard the material of this invention presents of course greater stiffness and strength. Pluralities of layers of corrugated wood may be assembled with each other, e. g. by gluing them together at or near the apices where they rest upon each other. This offers a hatched structure of great elasticity, when used as a filler.

Or flat sheets are interposed and assembled between layers of corrugated wood, yielding particular strength because of triangulation. One or more layers of corrugated wood or corrugated plywood may be suitably encased at their ends and sides.

Furthermore a plurality of assembled sheets of corrugated wood or plywood may be interposed, for instance in a limited width, and between boards, and will stuffiy space said boards apart.

In the drawings:

Fig. 1 diagrammatically illustrates an apparatus for assembling and corrugating plies of wood according to this invention.

Fig. 2 shows the corrugated sheet from the side, in longitudinal cross-section.

Fig. 3 is a side view illustrating the assembling into shaped plywood.

The remaining figures are perspective views.

Fig. 4 shows a sheet of corrugated and of flat ply assembled with each other.

Fig. 5 is the showing of a corner of a flat sheet of corrugated plywood.

Fig. 6 shows a section of a board, in which material of this invention is endwise interposed between cover boards. The end of one of the cover boards is shown to be lifted.

Fig. 7 shows a corrugated wood of this invention enclosed in a casing or frame. The flat cover plies are partly sectioned away.

Fig. 8 is the top end of a column, in which sheets of corrugated wood are assembled in honey comb formation in a continuous outer casing.

Similar letters refer to similar parts throughout the various views.

The apparatus of Fig. 1 provides for circular and chain conveyors for shaping corrugated wood and for engaging thereon and carrying it along. Thus the two chain conveyors 12 and 13 may have pulleys 11 at their ends, over which travels the belting 14. A surface meshing with the corrugated wood *a'* may be, for instance, provided upon the belting 14 by mounting thereon a corrugated resilient metal sheet 15, said sheet being fastened upon, e. g. riveted onto the belting 14 where it abuts thereupon.

The rollers 16, 17 and 18 are similarly peripherally fluted or corrugated, and may be suitably heated. For the latter purpose they may be hollow, so that steam supplied by a suitable pipe system 19 may be passed therethrough. The pipe system 19 includes a connection 20 to the level heating compartment 21. This compartment has a smooth surface upon which the finished product slides to the right, out of the machine.

These parts are mounted in the frame 22 of the apparatus, the pulleys and rollers 11, 16, 17 and 18 being rotatable and relatively adjustable, as it may be required for tightening the belt conveyors 12 and 13, and for providing between surfaces the clearance desired for a corrugated ply *a'* passed through the machine. At suitable points a plate or shield 23 may be provided for guiding and retaining the product passing over the conveying means or for supporting the conveyor chains or belts themselves. A synchronous drive (not shown) retains the rollers 16, 17 and 18 in meshing registry, and may also serve to drive one or more of the pulleys 11.

The frame 22 is loaded out in order to provide a platform 24 on which a ply *a* is slid into the machine, and also supports for the rolls of covering web *b* and for the gumming devices 25. These devices apply a suitable adhesive, e. g. glue, to the webs *b* before they pass into the machine, and to the apices of the corrugated wood *a'* as it swings into abutment with the cover ply *i* to be assembled at the bottom of the machine.

The operation is, for example, as follows:

The two gummed covering webs *b* and a pliable ply of wood, e. g. a sheet of freshly stripped wood *a* are drawn into the corrugating apparatus by the intermeshing, heated or corrugating rolls 16 and 17, and issue from said rollers as sheet of corrugated wood *a'*, which may be suit-

ably redirected by guides 23 for further heating and shaping around roll 17, between rolls 17 and 18 and around roll 18.

The two covering webs *b* were coated with an adhesive after they had been taken from the respective supply rolls and contacted with the gumming rollers of gumming devices 25. Sheet *a* of wood enters centrally between said webs *b* and the three layers are assembled just before they are forced together in corrugated formation by the overlapping teeth of the rollers 18 and 17. It is particularly noted that the corrugated sheet is reversed and bent in opposite direction around roll 18 during the thermosetting operation.

It is the object of the protective covering *b* to keep the sheet *a* from bursting and shrinking, to prevent the corrugated wood from splintering if handled, bent, cut to size, etc., to intercept humidity and prevent reaction of the wood to changes of pressure, humidity and temperature of the atmosphere, and, generally, to help to preserve a fixed and predetermined shape of corrugations. When the corrugated wood *a* is subsequently assembled into corrugated plywood or otherwise, the protective covering also prevents undue influence of adhesive additionally applied.

After films have thus been applied to both sides of the ply *a*,—which will be done more often then applying only one film to the ply,—the corrugated sheeting *a'* has the appearance indicated in Fig. 2, when it enters between the conveyors 12 and 13.

In the continuity of the operation of the apparatus of Fig. 1 the corrugated wood may then be incorporated in the plywood. The drawing indicates for such purpose a gumming device 25 at the left end of the machine, which gums the apices of corrugations at the wood as they pass down over conveyor 13. Before the freshly gummed corrugated wood passes onto the heater 21, a flat ply of wood, e. g. *i*, is fed between the moving corrugated wood and the heater, the heater setting the abutting faces in adhesion, and they pass out of the machine to the right as a corrugated plywood *a'i*. The grain of ply *i* is presumed to run normal to the direction of the grain of the corrugated wood *a'*, so that the product is a stiff board, as shown in Fig. 4.

If plies *i* are applied to opposite sides of the corrugated board *a'* the plywood of Fig. 5 is obtained.

If instead of ply *i*, in which the grain runs athwart that of the ply *a'*, a ply *j* is used, in which the grain runs in the same direction as that of the corrugated wood *a'*, then the resulting plywood *t* is still flexible, and may for instance be arranged to extend in the curve indicated in Fig. 3. But if then another ply *j*, in which the grain also runs in the same direction as in the corrugated wood *a'*, is glued onto the top of the corrugated plywood *c*, the curve is permanently set in the resulting plywood *d*.

Of course the veneer applied to one or both sides of the corrugated ply may be plywood by itself, as suggested in Fig. 7.

Here as well as in the other instance where the corrugated wood produces voids in the finished material, the void may be filled itself with suited materials, like cork, etc., or there may be a coating or packing of layers of gypsum, e. g. together with saw dust, concrete, tar, cement, etc.

Along the margin of a board the space between the veneer *i*, *j* or *ij* may be outwardly closed by boards *p* and *q*, as indicated in Fig. 7. Substantially in alignment with the clearances of the corrugated wood *a'* the wooden strip *q* may be transversely grooved, for instance by way of half round openings *r*, which serve as air ducts. A panel of this kind is suitable for doors, walls and the like.

A number of sheets of plywood like that shown in Fig. 4, which comprise one layer of corrugated wood *a'* and one layer of flat wood *i* with grains running rectangular to each other, may be stacked and glued together in multiple formation. Fig. 6 shows, that such a formation may be cut to extend at a limit width and may then be glued at the cut ends to opposite boards *m* and *n*, which are thus rigidly spaced apart.

In such honey comb arrangement the central flat partitions may be omitted for other purposes, for instance in connection with a pillar like that shown in Fig. 8, where the corrugated boards *a'* are glued together at their apices and also onto the surrounding angular frame of boards *s* and *t*, and will thus complete the assembly of a rigid post or column.

It is understood that in all cases the board *m*, *n*, *s* and *t* or the veneers *i* and *j* do not necessarily have to be made of wood, but may also be any of the many other sheet materials known today, as they are cardboard, sheet metal, pressed board, sheets of condensation products and other synthetic resins, etc.

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