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(54) **PROCEDE D'ASSEMBLAGE PAR ADHESION DE PRODUITS EN BOIS OUVRE**

(54) **METHOD OF ADHESIVELY ASSEMBLING MILLED WOOD PRODUCTS**

(57) Un procédé propre, net et efficace d'assemblage par adhésion de produits en bois ouvré consiste à placer près des surfaces à unir un dispositif comprenant un élément cible contigu à une matière adhésive thermoactivable, ledit élément cible absorbant les ondes électromagnétiques convertibles en énergie thermique afin d'activer ladite matière adhésive, à maintenir lesdites surfaces ensemble et à exposer ledit dispositif à des ondes électromagnétiques afin de produire une chaleur suffisante pour activer la matière adhésive afin qu'elle établisse une relation de liaison entre les pièces de bois ouvré assemblées.

(57) A clean, neat and effective method for adhesively assembling milled wood products entails placing adjacent to the surfaces to be joined a device which comprises: a target element contiguous with a heat activatable adhesive material, said target element being absorbent of electromagnetic waves which are convertible to heat energy to activate said adhesive material, holding said surfaces together, and exposing said device to electromagnetic waves to produce heat sufficient to activate the adhesive material to effect a bonded relationship between the assembled milled wood pieces.

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(54) Title: METHOD OF ADHESIVELY ASSEMBLING MILLED WOOD PRODUCTS

(57) Abstract

A clean, neat and effective method for adhesively assembling milled wood products entails placing adjacent to the surfaces to be joined a device which comprises: a target element contiguous with a heat activatable adhesive material, said target element being absorbent of electromagnetic waves which are convertible to heat energy to activate said adhesive material, holding said surfaces together, and exposing said device to electromagnetic waves to produce heat sufficient to activate the adhesive material to effect a bonded relationship between the assembled milled wood pieces.

METHOD OF ADHESIVELY ASSEMBLING MILLED WOOD PRODUCTS

CROSS REFERENCE TO RELATED APPLICATION

This application relates to U.S. Patent Application Serial No. filed on even date herewith and entitled "Adhesive Device" by Shomler et al. Said application and its disclosure are hereby incorporated by reference.

BACKGROUND OF THE INVENTION

This disclosure relates to the assembly of a variety of milled wood products using an adhesive device that is activated by electromagnetic waves. The milled wood products include articles of relatively simple construction such as lattice panels, fencing, pallets, skids, crates, decks and docks, bird and dog houses, trellises, gazebos, patio benches and tables ant the like.

The assembly of simple milled wood products is typically effected by employing mechanical fastening devices such as hand or power driven nails, staples, tacks and brads. However, these fastening devices have some disadvantages: The milled wood is frequently damaged by splitting if the metal fastener is too large or carelessly driven, and the fastener itself will occasionally "pop" loose in cold weather. In damp climates, of course, the fastener has a tendency to rust, staining the milled wood and, eventually, working free. Nail and staple heads can also protrude and thereby snag and damage cargo or handlers of cargo. If the wood is split, then the quality or integrity of the joint is compromised.

Also, adhesives have been developed which are safer to work with and produce attachments that are actually more secure than the mechanical fastening methods. However, the use of adhesives alone is not the final answer. Adhesives are messy and difficult to apply to "hidden" or inaccessible places. They can stain the material of the pieces to be assembled, and they are typically over-applied because it is difficult to control the proper amount to be used. Also, if the wood is wet, adhesives should not be used. It is apparent, then. that inventions are waiting to be made which address the placement of adhesive material in a neat, clean, safe and effective manner that can be used beneficially in the in the wood fabrication industry, and especially with regard to the fabrication of simple. low-cost, modest-profit items that must be constructed to specific quality standards as efficiently as possible.

Not surprisingly then, others have experimented with alternatives to traditional fastening devices for attaching construction materials to a work surface.

DESCRIPTION OF THE PRIOR ART

United States Patent 4,038,120 to Russell describes the use of an energized heating element or wire to heat a hot melt glue resulting in adhesion between contiguously assembled panels. The reference method involves heating a glue-coated wire to liquefy the glue producing a cohesive state and facilitating the assembly of panels. This method is particularly useful for introducing a cohesive material (glue) to an area of limited accessibility (groove), but the heating element (wire) requires the direct application of energy (electricity) to provide the heat to melt glue.

~~United States Patent 3,574,031 to Heller et al. describes a method and material for~~

Austrian Patent AT-A-321432 is directed to a method for joining two bodies using an adhesive containing a conductive substance. In one embodiment, a target element can also be an extra layer contiguous to the adhesive.

Japanese Publication No. 63120786 describes a method of bonding in areas where bonding by conventional techniques is impossible by placing a conductive heat-generating material along a crosslinkable resin composition and passing a current through the heating material to expedite the crosslinking of the resin by making use of the generated heat.

United States Patent 3,574,031 to Heller et al. describes a method and material for

welding thermoplastic bodies by using a susceptor between the bodies to be joined. The susceptor sealant is characterized by having particles, heatable by induction, dielectric or radiant energy, dispersed in a thermoplastic carrier compatible with the thermoplastic sheets to be welded. The welding of the thermoplastic sheets is effected by exposing the susceptor sealant to heat energy, softening the carrier material and joining all thermoplastic materials.

United States Patent 3,996,402 to Sindt relates to the assembly of sheet materials by the use of a fastening device utilizing an apertured sheet of eddy current-conducting material sandwiched between coatings of hot-melt glue. An induction heating system is activated causing eddy current heating in the EC-conducting material with consequent melting of the hot-melt glue thus resulting in fusion and, ultimately, bonding of the sheet materials in accordance with the desired construction.

SUMMARY OF THE INVENTION

The presently disclosed method of adhesively assembling component pieces of a milled wood product is distinguished from, and improves upon, the prior art by utilizing a device to be placed adjacent to surfaces of the pieces to be joined which comprises a target element contiguous with a heat activatable adhesive material said target element being absorbent of electromagnetic waves which are convertible to heat energy for activating the adhesive material, holding said surfaces together, and exposing said device to electromagnetic waves to produce heat sufficient to activate the adhesive material to effect an adhesive bond between the component pieces of the assembled milled wood product.

DESCRIPTION OF THE PREFERRED EMBODIMENT

It is imperative that the assembly of simple milled wood products be constructed as efficiently as possible. There is not a lot of technology or know-how in the fabrication of such items. Typically, they're made of low grades of milled wood fastened by using traditional mechanical fastening devices such as nails, brads and staples. It is believed that the disclosed method of assembling milled wood products will provide definite advantages of cost, quality, safety and appearance over traditionally fastened wood products.

By the term "milled wood" products is meant all lumber goods including solid wood boards, strips. planks, sheets and composite and laminated wood products including solid dimensional lumber, plywood, fiber board, OSB, pressed board and all manner of resin-filled particle board.

Also, bear in mind that these milled wood products are characteristically made in in-plant production line operations removed from the job site. They're made with standard pieces according to standard specifications. This uniformity of composition and process is well suited for the employment of an adhesive device that can be desirably situated between or adjacent to pieces to be joined in the assembly of the product and activated to adhesively join the components into a sturdy, well-constructed product.

Looking at the adhesive device employed in the disclosed method in greater detail, we see that the target element must, for the most part, be fashioned from materials or substances that are not transparent to electromagnetic waves. Indeed, the target

element will necessarily be constructed of a composition that will absorb electromagnetic waves. Once absorbed by the target element, these waves will produce magnetic hysteresis and eddy currents resulting in heat energy which will melt or activate the contiguous adhesive material.

Typically, the target element will be fashioned from metallic materials such as steel, aluminum, copper, nickel or amalgams thereof which have proven utility and are readily available; although, some semi-metallic materials such as carbon and silicon are also known to be suitable for the absorption of electromagnetic waves.

The target element can assume any form or shape consistent with the overall configuration of the adhesive device and intended application. Frequently, the target element will be presented as a metallic foil, mesh or strip, and, in some instances, it will be more effective to present the target element in the form of a fiber, chip or flake of an electromagnetic absorbable material. The point to be made is that the target element need only be fashioned from a material reasonably impervious to, and absorptive of, electromagnetic waves.

In use, the adhesive device needs to be situated adjacent to the pieces of the milled wood product to be assembled. As a practical matter, of course, all wood products are transparent to electromagnetic waves. Some milled wood products will be more transparent than others, and empirical adjustments can and will be made to modulate the quantity and intensity of electromagnetic wave energy needed to optimally activate the adhesive material.

In many instances, it will be sufficient for the adhesive device simply to be

placed adjacent to the milled wood pieces to be assembled. In other construction or assembly situations, it will be necessary to make some arrangements or take additional steps to make sure the adhesive device remains in place prior to activation. Such an additional step need be little more than introducing an attachment element such as a small pressure sensitive adhesive area on the surface of the device . Simpler means for positioning the device prior to activation might entail clamping, tacking, stapling, spiking or even snap-fitting by slotting the article and grooving the work surface to make sure the adhesive device is situated and activated in the most effective and, therefore, most desirable location. But these measures, of course, would be optional procedures and in no way essential to the performance of the device in its broadest typical and routine applications.

When desirably situated adjacent to the pieces of the milled wood product to be assembled, the adhesive device is ready to be exposed to electromagnetic waves, produced by and emanating from a generator powered by a source of alternating electric current. The generator can be held in a fixed position for assembly-line production or designed to be manipulated so as to quickly and easily pass over, around or near the strategically "hidden" device while emitting electromagnetic waves which will penetrate the "transparent" pieces of the milled wood product to be assembled, be absorbed by the target element, be converted to heat energy, activate the adhesive material resulting in a bonded relationship between the pieces of the milled wood product..

To elaborate, somewhat, heat is produced in the conductive target element by two mechanisms: eddy current resistive heating and magnetic hysteresis. Eddy current

resistive heating applies to all conductive materials and is produced in the target element by the electromagnetic waves emanating from the generator. The heat resulting from magnetic hysteresis is observed only in magnetic materials. As the electromagnetic field produced by the generator reverses polarity, the magnetized atoms or molecules in the target element also reverse. There is an energy loss in this reversal which is analogous to friction: This energy loss is magnetic hysteresis. The "lost" energy is quickly converted to heat and conducted by the target material to the contiguous, and frequently enveloping, heat-activatable adhesive material to initiate adhesion.

When heated to the necessary temperature, the adhesive material will liquefy or become heat-activated, attach itself to the surfaces to be joined and, on cooling, create an adhesive relationship between the component pieces of the assembled milled wood product.

Two adhesion mechanisms, hot-melt and heat-activated cure, are proposed for use with the disclosed device. Both mechanisms are initiated by heat emanating from the target element. Hot-melt adhesives are solid at ambient temperatures, but melt or liquefy when the temperature is elevated by, for instance, heat accumulating in the target element. The melted adhesive "wets" the adherends and, in the case of porous or fibrous adherends, penetrates the surface of the pieces to be bonded. As the adhesive cools, the adherends and adhesive are bonded by the electrostatic attraction of polar molecular groups. In the case of porous or fibrous adherends, mechanical interlocking can contribute to bond strength. Note that for the hot-melt mechanism, the bonding is reversible. Thus by repeating the induction heating procedure, the bond can be undone

and the adherends separated. The ability to reverse the adhesion and separate assembled mill wood products is not a trivial attribute. In addition to the obvious advantage of being able to reassemble or repair misaligned pieces, it may also be desirable to be able to disassemble milled wood products to facilitate serviceability and repair. This ability to reverse the adhesion and separate bonded pieces will play a significant role in waste reduction and, when appropriate, will permit recycling the component parts.

Heat-activated curing adhesives are also solid and easy to manipulate at ambient temperatures, but when the adhesive temperature is elevated by, for example, the heat emanating from the target element, a chemical reaction is initiated. This reaction involves a cure or crosslinked bonding either within the adhesive or between the adherends. Such bonds are typically irreversible. Frequently, a heat-activated curing adhesive bond will demonstrate an electrostatic attraction between the adhesive and the adherends and a crosslinked bond within itself.

While the foregoing is a complete description of the disclosed method, numerous variations and modifications may also be employed to implement the purpose of the invention. And, therefore, the elaboration provided should not be assumed to limit the scope of the invention which is intended to be defined by the appended claims.

Claims:

1. A method of assembling milled wood products, which comprises:

placing adjacent to surfaces of milled wood pieces to be joined a device comprising a target element contiguous with a heat activatable adhesive material, said target element being absorbent of electromagnetic waves which are convertible to heat energy to activate said adhesive material, holding said milled wood pieces together, and exposing said device to electromagnetic waves to produce heat sufficient to activate the adhesive material to effect a bonded relationship between the milled wood pieces, characterized in that said target element is composed of a continuous metallic foil strip having no apertures within the body of said strip.

2. A method as recited in claim 1 wherein said foil strip is non-magnetic.

3. A method as recited in claim 1 wherein said foil strip is manufactured from a metallic material taken from a group consisting of aluminum, copper, and steel.

4. A method as recited in claim 1 wherein said heat activatable adhesive material is a hot-melt adhesive.

5. A method as recited in claim 1 wherein said heat activatable adhesive material is a heat-activatable curing adhesive.