

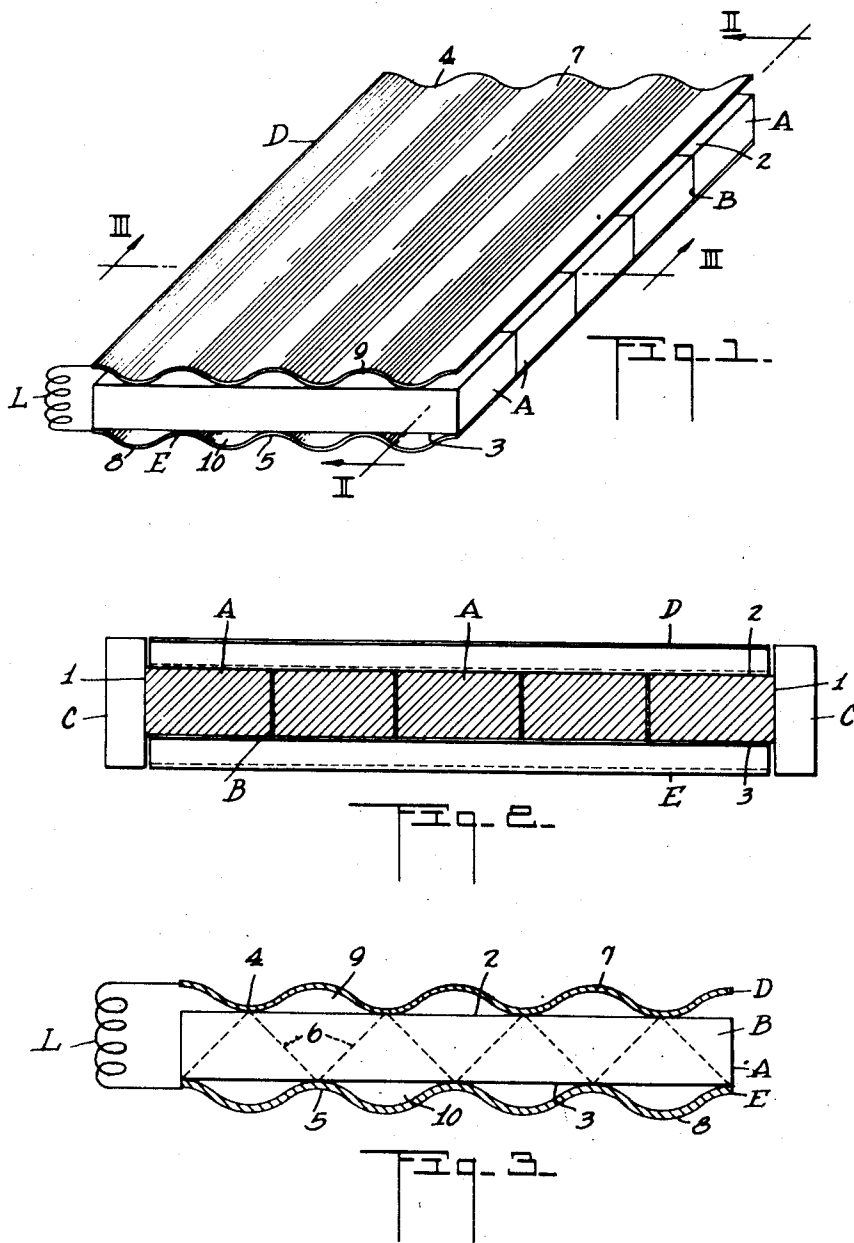
Dec. 28, 1948.

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2,457,498

RADIO FREQUENCY PARALLEL BONDING

Filed Dec. 11, 1945



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2,457,498

RADIO-FREQUENCY PARALLEL BONDING

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Application December 11, 1945, Serial No. 634,323

3 Claims. (Cl. 154—116)

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An object of our invention is to provide for certain types of laminating a radio frequency parallel bonding process and electrodes which is an improvement over the form of the invention shown in our Patent 2,434,573 granted Jan. 13, 1948, on a co-pending application in which we disclosed "Parallel bonding." We showed a plurality of layers of wood and adhesive placed between the plates of a condenser through which adhesive layers high frequency energy is caused to pass. The glue lines between the layers of wood extend perpendicular to the planes of the condenser plates and this will cause the high frequency energy's lines of force between the condenser plates to parallel the glue lines rather than extend perpendicular thereto. The lines of force then follow the more conductive path of the adhesive line more readily.

In the present form of the invention, we make use of corrugated electrodes which are for the purpose of causing a concentration of high frequency field lines of force to pass through certain portions of adhesive planes perpendicularly disposed between them. The corrugations of the electrodes extend at an angle to the glue planes. The corrugations in one electrode are staggered with respect to the corrugations in the opposite electrode and, so that when the corrugations cut at any angle across the adhesive lines, they will cause a dominant concentration of the high frequency field of force to form a Z-shaped or saw tooth pattern in the planes of the adhesive, as the electrodes are in their respective turns alternately charged from a source of high frequency alternating current.

In Patent 2,434,573, the entire glue line or plane will absorb the high frequency field of force and therefore the entire area of the adhesive will be affected. In the present case, the dominant lines of force of the high frequency field do not necessarily pass along all of the entire adhesive plane area, but concentrate to take a Z-shape or zigzag course therethrough. Sufficient heat may be developed by the said field of force to set the entire glue area, or may bond the adhesive only along the Z-pattern described, depending on the power applied and the time interval of exposure to the field.

The advantage of this invention over the disclosure in our aforementioned patent is to speed up the setting of adhesive lines in laminated wood or between blocks of material that are considerably larger than small strips of wood or veneer. It is possible to rapidly set the glue lines between furniture core stock; piano sounding

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boards and other such assemblies with this arrangement and type of electrodes. Furthermore, the edge gluing of laminates in many varying thicknesses, widths and lengths, may be more rapidly accomplished.

Using the flat electrodes described in said Patent 2,434,573 as compared with the corrugated electrodes described herein requires a greater power in the high frequency generator to accomplish equally fast glue setting times in comparable laminates.

Other objects and advantages will appear in the following specification, and the novel features of the device will be particularly pointed out in the appended claims.

Our invention is illustrated in the accompanying drawings forming a part of this application, in which:

Figure 1 is an isometric view illustrating our new type of corrugated electrode applied to a plurality of pieces of stock which are to be glued together;

Figure 2 is a transverse section taken along the line II—II of Figure 1; and

Figure 3 is a longitudinal section taken along the line III—III of Figure 1.

While we have shown only the preferred forms of our invention, it should be understood that various changes or modifications may be made within the scope of the appended claims without departing from the spirit and scope of the invention.

In carrying out our invention, we make use of a plurality of pieces of stock, such as the wood pieces shown at A in Figures 1 and 2. Figure 2 illustrates layers of adhesive B placed between the adjacent wood pieces. Pressure blocks C may be disposed at the outer sides of the outer pieces A for forcing the blocks together with the required pressure during the application of radio frequency field of force thereto.

Corrugated electrodes D and E are placed on the upper and lower surfaces 2 and 3 of the pieces A, respectively. Figures 1 and 3 illustrate how the material contacting corrugations in the electrode D are staggered with respect to the material contacting corrugations in the electrode E so that the valleys 4 of the electrode D will be disposed midway, or at some other point between the crests 5 of the electrode E. The valleys 4 contact with the surface 2 while the crests 5 contact with the surface 3, although they need not actually make contact with these surfaces.

In Figure 3 we illustrate how the radio frequency field of force will concentrate from one

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valley 4 of the electrode D to the adjacent crests 5 of the electrode E; the dotted lines 6 representing the dominant course taken by the field lines of force which form a Z-shaped or saw tooth pattern along the layer of adhesive B. The adhesive lying between the electrodes offers a better conductive path for the field lines of force than the other material or surrounding air and the shortest path will be along the dotted lines 6. The adhesive lying in the paths taken by these lines of force will be instantly set because there will be a concentration of energy along the paths roughly represented by dotted lines 6. The heat generated by this energy may be sufficient to set the adhesive areas lying adjacent to the waves so that in effect the entire adhesive layer will be raised to the temperature required for setting, while under the field's influence.

Should the corrugated electrodes D and E be shifted so that the valleys 4 and crests 5 will be disposed directly opposite each other, a spot glue effect would be produced in the adhesive layer B. The Z or saw tooth pattern will take place when the valleys 4 and crests 5 are staggered with respect to each other and will cause a set glue line to be formed which will be part way between a completely set glue line shown in our co-pending case and the spot glue line resulting when the valleys and crests are disposed opposite to each other. The zigzag pattern of glue setting will provide a truss pattern effect in the glue plane that will be coextensive with the length of the electrodes above and below the glue line extending from the top to the bottom of the glue plane. In Figure 2, the electric field and therefore the heating will pass between the electrodes mainly through the adhesive planes B and since these planes extend perpendicular to the planes of the electrodes, parallel bonding will result because the field lines of force of the electric field will parallel the planes of the adhesive lines. Some energy will be dissipated in the dielectric being bonded but by far the greater amount of energy will be dissipated in the glue lines which are more conductive in their nature to the field lines of force than would be the dielectric being bonded.

It should be noted that the electrodes D and E will exert sufficient pressure to prevent the wood blocks A from buckling when pressure is applied to the blocks C for clamping the wood pieces together. This arrangement is clearly shown in Figure 2. The dominant field lines of force will follow the glue lines B between the top and bottom plates D and E in the Z-shaped pattern shown in Figure 3. The crests 7 and the valleys 8 of the electrodes D and E provide air spaces between these portions of the electrodes and the wood or other dielectric pieces to be laminated. The radio frequency field lines of force will follow along the dotted lines 6 rather than flow from the valley of one electrode to the valley of the other electrode since the field lines will take the shortest conductive path which is through the wet glue rather than through the air spaces 9 and 10 provided between the crests 7 of the electrode D and the adjacent surface 2, and the valleys 8 of the electrode E and the adjacent surface 3. An inductance L is shown connected to the plates D and E in Figures 1 and 3. This denotes only that the electrodes are connected to a radio circuit or source of high frequency power, not shown, but which may be of the type shown in our co-opending application on a Single

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standing wave radio circuit, Serial No. 510,566, filed November 16, 1943.

The high frequency field of force in making a Z-shaped pattern in the adhesive plane will set the adhesive immediately along this line. The Z-shaped pattern provides a truss effect for bonding the two adjacent pieces together. This truss support is immediately provided and permits a very fast gluing operation. The areas of glue lying outside of the truss support, Z-shaped lines or areas can set from the heat generated by the radio frequency field of force or can cold set in the same manner that any room temperature setting glue will set when subjected to ordinary temperatures and exposed to the air, the part set by the high frequency field being in proportion to the time of the radio frequency exposure, a thin Z or truss pattern being obtained with a short exposure.

Although shown so in the drawings of Figure 1, it is not essential that the length of the corrugations extend at right angles to the planes of the adhesive lines, but may cross them at any angle, or even parallel the lines of adhesive themselves. All of these methods have successfully been employed in adapting this technique to "parallel bonding," in the tests conducted to prove the merit of this invention.

The batch process herein described may be adapted to a continuous process of gluing wherein the length of the corrugations or electrodes, whatever is desired, are placed at some convenient angle between parallel and perpendicular to the plane of the adhesive lines as they pass between electrodes or crests of electrodes which are corrugated as shown herein. One, two or more crests may be employed.

We have disclosed in the drawings corrugated electrodes; we wish also to have it understood that as a substitute for corrugated electrodes of a continuous piece of metallic material used as the electrodes, this invention covers the use of a series of tubes or bars connected into a type of grill work which placed above and below a glue line and staggered in the manner disclosed for the corrugated types would perform substantially the same desirable end performance as electrodes in parallel bonding. In the latter case, the lower portions of the bars or tubes would perform the same function as would the valleys 4 and crests 5, shown in this application on the corrugated electrodes.

The use of corrugated electrodes or pipe or bar electrodes made into an assembly to simulate a corrugated sheet has a distinct advantage over flat plates in that glue squeeze-out is caught in the valleys of the lower corrugations and does not build up on top of the edges used for the concentration of the field of force. Glue squeeze-out problems resulting from the application of a proper gluing pressure has been a bothersome factor until we developed the corrugated electrode to aid in overcoming this factor.

We claim:

1. A method of bonding abutting edges of material which comprises placing the material in abutting relationship with a thermo-responsive adhesive therebetween and then subjecting the thus formed joint to a high frequency electrostatic field disposed in a zig-zag manner parallel to the abutting edges within the plane of said adhesive to activate the said adhesive within the said electrostatic field areas of the joint.

2. The method of bonding separate pieces of wood consisting in applying between their ad-

jacent abutting edges an adhesive and subjecting the plane of said adhesive to a high frequency electrostatic field in which the dominant lines of force extend therethrough in a zig-zag pattern and effect setting of the adhesive in a similar pattern.

3. The method of bonding abutting edges of separate pieces of material which comprises applying a thermo-responsive adhesive to said edges, subjecting the plane of the joint thus formed to a high frequency electrostatic field in which the dominant lines of force pass through the adhesive in said plane in a zig-zag truss pattern extending between the edges of said plane to quick set said adhesive in said pattern and thereafter allowing the remainder of the adhesive to cold set.

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