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G. F. LINQUIST

2,317,281

EDGE GLUING PROCESS

Filed April 9, 1942

Fig. 1.

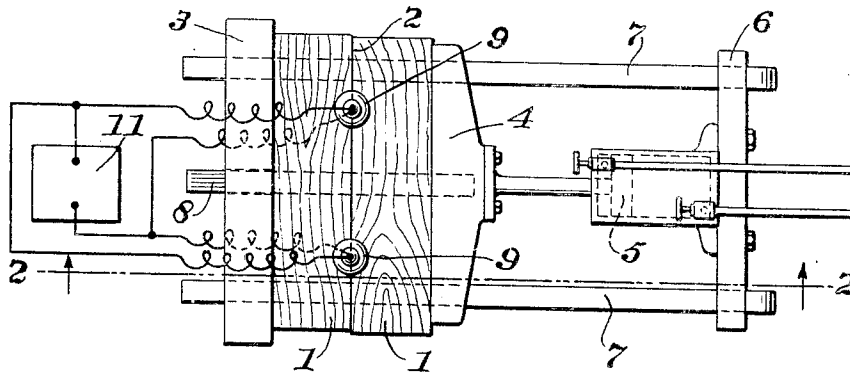


Fig. 2.

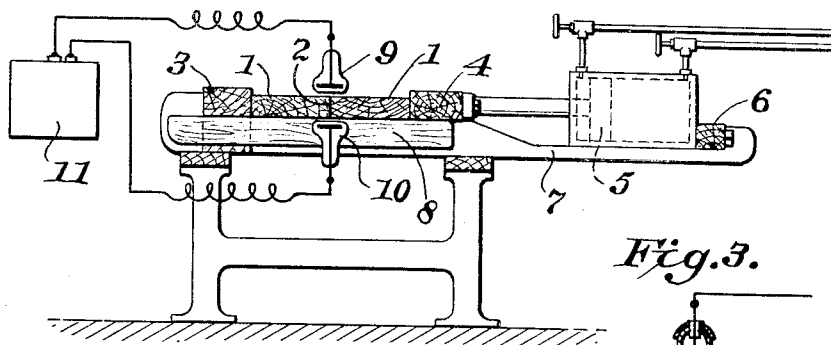


Fig. 3.

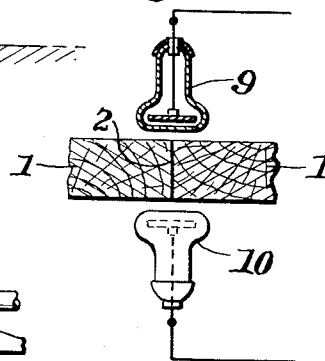


Fig. 4.

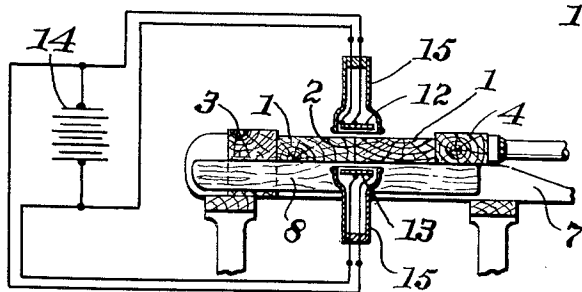


Fig. 5.

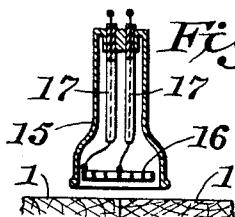
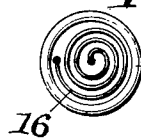


Fig. 6.



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UNITED STATES PATENT OFFICE

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EDGE GLUING PROCESS

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7 Claims. (Cl. 144—309)

This invention relates particularly to an improved method of edge gluing together narrow lengths of lumber and similar material incidental to the production of wider stock used in making dresser tops, desk tops, ironing boards, shelving, pattern lumber, box ends and the like. The principal object of the invention is to greatly shorten the period during which the glued-up assemblies have to be held clamped together by some mechanical device while the glue is hardening or setting.

This clamping period, which must be continued until no separation of the parts will occur upon removal of the clamps, has run from a minimum of about fifteen minutes to a number of hours depending on the type of glue and equipment. Even with the most quick-setting glues, the investment in clamping apparatus has been very considerable and the output per clamp undesirably small. Complicated and expensive arrangements of clamps mounted on conveyors are frequently used to increase output. In some instances where a steady, large volume of output is required, it has been found necessary to provide expensive auxiliary equipment in order to shorten the clamping period. One method of releasing the clamps for earlier re-use has been to use an auxiliary dry kiln into which the clamped-up articles are transferred to hasten the setting of the glue by the influence of heat. In any case, with or without the assistance of supplementary heat, an excessive outlay of capital for clamping equipment has been an unavoidable burden on the manufacture of edge-glued wood products. Furthermore, in most industries requiring these products, the footage of edge-glued surface has been much increased as the available stock has become narrower due to utilization of lower grade timber as the original source of supply.

The present invention eliminates this restriction by multiplying many fold the output that can be obtained from clamping equipment. Furthermore, it permits the use of simpler and faster working clamps since the duration of the clamping period is reduced to a matter of seconds instead of minutes or hours.

As is indicated by the previous mention of an auxiliary dry kiln for speeding up the setting of the glue, all the commonly used adhesives for edge-gluing lumber are cold-setting glues capable of setting up and forming their ultimate bonds at room temperature but cold-setting glues in general also respond to the influence of heat to accelerate the setting action. Animal

glue, for instance, sets by a simple process of gellation, mainly due to the glue moisture being absorbed by the adjacent relatively dry wood surfaces. Other adhesives, such as casein glue, set partly by an internal chemical gellation process and partly by absorption. Cold-setting, acid-catalyzed urea resins are now coming into extensive use for edge gluing and these set mostly by internal action due to polymerization under the influence of the acid catalyst with only a minor amount of assistance from absorption of excess moisture into the wood. While these glues are ordinarily used as cold process adhesives in edge gluing, all of them and cold-setting glues in general have the common characteristic that their rate of bond formation can be accelerated by heat. When animal glue is used, heat speeds up the absorption of the glue moisture into the wood and consequent hardening of the glue jelly. In the case of casein glues and urea resins, the heat also speeds up the chemical processes while hastening moisture absorption. With acid-catalyzed urea resins, the acceleration due to heat is very great and it is also considerable with casein glues. It will thus be seen that, if it were commercially possible to apply heat effectively the clamping period would be greatly shortened. For this reason, the use of dry kilns in connection with edge gluing has proved worthwhile even though it is a costly and inefficient expedient because the method of applying the heat involves heating up the whole assembly including both the clamps and the wood. Furthermore, the heat which penetrates to the vicinity of the glue line is the only part of the total heat expenditure which is effective and this has first to be transferred by means of a large volume of air from the steam pipes or other source of heat to the assembled parts and then slowly conducted into the interior of the wood. The kiln is also an expensive and bulky piece of equipment.

I have now made the important discovery that not only can the kiln be eliminated but the use of the clamps can be shortened to a few seconds. I accomplish this by departing from the method of heating the entire glued area and instead only heat a small part of the total area usually in a few properly located spots. I find that after this very short clamping and local heating procedure the glue itself, acting in this small area, is amply able to perform the function of clamping the whole assembly together while the major proportion of the glue is setting up by the usual slow process of gel formation at room tempera-

ture. By this new method, I am able to release the clamps for re-use in a small fraction of the time previously required.

In the accompanying drawing, two slightly modified forms of apparatus for carrying out the method of the present invention are shown diagrammatically, for purposes of illustration.

In the drawing:

Figure 1 is a plan view.

Figure 2 is a vertical section taken substantially on line 2—2 of Figure 1.

Figure 3 is a fragmentary view on an enlarged scale, showing diagrammatically, high frequency radio electrodes.

Figure 4 is a fragmentary vertical section, showing a modification, using radiant heating elements.

Figure 5 is an enlarged vertical section of one of the elements, and

Figure 6 is a bottom plan view thereof.

Referring now to the drawing in detail:

Numeral 1 indicates two sticks of wood, for instance 1" x 6" lumber, to be united by glue applied along the line of edge contact between the two sticks indicated by the numeral 2. The glue may be any of the common, cold-setting glues, all of which are capable of having their rate of bond formation accelerated by the use of heat, such as, for example, animal glue, casein glue, or acid-catalyzed, urea resin glue. Numeral 3 indicates a firmly supported, abutting member which receives the thrust of the assembled sticks 1 which are pushed together into gluing contact by the action of the pusher bar 4 actuated by the piston 5 which is supported by the frame 6 which is tied together to the abutment 3 by the two strain rods 7. The piston 5 for applying the clamping pressure may be actuated by any convenient means such as air, steam or water pressure.

In Figures 1 and 2 the supporting bar 8 is preferably made of wood, although the remaining parts are desirably made of metal. This supporting bar 8 is attached to and carried by the pusher 4 and is free to slide with the movement of the pusher bar 4 through a slot provided in the abutment 3. The supporting bar 8 is merely to furnish an intermediate support for the sticks 1 which are to be glued. The reason for making the supporting bar of wood is because, as will be explained subsequently, the apparatus is preferably to be used in connection with high frequency radio electrodes and it is undesirable to have any large masses of metal close to the electrodes because such metal masses, if not removed at least six inches from the vicinity of the electrodes, tend to induce stray currents which diminish the output of the electrodes; also, the metal parts if touched may cause painful burns if they are allowed to become energized. These precautions will be well understood by those who are skilled in the operation of radio apparatus.

High frequency radio electrodes 9 and 10 are connected by suitable leads to a radio frequency power generating unit 11 of known design, the electrodes of each pair being positioned above and below the glue line, substantially as shown. The high frequency radio electrodes may be supported by any suitable apparatus, but since the supporting means do not constitute a part of the invention in the present application, they are not shown in detail herein.

When employing radiant heat for the purpose of setting the adhesive, heating elements 12, 13, positioned above and below the glue line in pairs

and connected in parallel to a source of current 14, may be employed, the heating elements preferably being mounted in housings 15 supported by any appropriate apparatus, or by hand.

As suggested in Figures 5 and 6, the heating elements may be in the form of coils 16 of resistance ribbon, supported by insulated posts 17 carried by the casing 15.

The following examples are to be considered as illustrative of the principle of my invention and are not to be construed as limiting its application except as set forth in the appended claims.

EXAMPLE 1

If this apparatus is used as a clamp for gluing together the sticks without any provision for heating the glue line, of course the gluing pressure will have to be maintained from the piston 5 until the entire length of the glue line 2 has become set up so that no separation of the wood members 1 will take place upon release of the clamping pressure. As previously explained, this duration of clamping pressure might run from a minimum of about fifteen minutes to a maximum of a number of hours.

With an apparatus of this sort, as shown in Figure 4, and two sticks of 1" x 6" lumber 2 feet long, I provided two pairs of electrically heated, radiant heating elements, indicated by the numerals 12 and 13, each member of one pair being located respectively directly above and below the glue line about six inches from one end of the sticks and the other pair similarly located six inches from the opposite end. Each member of the pair was spaced with its heat-radiating elements just out of contact with the surface of the wood and in register directly above and below each other so that when the electric current was turned on, heat would be radiated from the glowing heating elements against a small area of the glue line and adjacent wood. The length of the glue line heated by each pair of elements was about 1½ inches. The adjacent wood in a circle about 1½ inches in diameter was, of course, also heated. An acid-catalyzed, cold-setting, urea resin glue was applied which would ordinarily require about six hours to set up sufficiently to permit removal of the clamping pressure. The sticks were clamped together and electric current was turned on from the power supply so as to heat the two spots of the glue line as rapidly as possible without scorching the surface of the wood. The heat was left on for fifteen minutes and then the clamp was released and the sticks broken apart. It was found that there was strong adhesion for about 1½ inches of glue line length at each of the two spots that had been heated and the failure of the joint occurred mostly in the wood at these two places. The remainder of the glue line showed no adhesion and the glue was still moist and had not set appreciably. Before the sticks were broken apart, it was noted, however, that the whole length of the glue line was firmly held together by the clamping action of the two heat-set spots of glue.

The foregoing process was then repeated and the assembly removed from the clamps after fifteen minutes local heating of the spots. It was allowed to remain undisturbed until the next day and was then broken. It was found to be strongly glued over its entire length and no particular difference was noticed in the amount of wood failure or strength of the bond in the location of the two heat-set spots as compared to the re-

mainder of the glue line which had been allowed to cold-set in the usual way.

EXAMPLE 2

The four radiant heating elements 12, 13 were then removed from the clamping apparatus and replaced by four radio frequency vacuum electrodes 8, 10 in the same locations and relationship to the glue line. These were supplied with high frequency current alternating at about 30 megacycles from a radio frequency power generating unit 11 of known design capable of delivering about $\frac{1}{2}$ kilowatt of heating energy to each of the two pairs of electrodes. The process of Example 1 was repeated except that, after clamping together the glue-spread assembly, the current was turned on the electrodes for only ten seconds whereupon the assembly was released and removed from the clamps. It was noted that the clamping action of the heat-set glue spots was again satisfactory. The sticks were then broken apart. They were found to be strongly stuck with wood failure along about the same areas as in the previous experiment. It was noted, that, while in the previous example a considerable mass of the wood was heated at the location of the heating elements, in this instance the wood was scarcely heated at all although the glue line at the location of the spots felt slightly warm. In other words, due to the high frequency of the polarity oscillations induced in the wet glue substance, the heat had been generated selectively in the glue by the well-known phenomenon of molecular friction while the relatively dry wood had been heated only slightly. While this method of setting glue by selective heating due to molecular friction under the influence of a very high frequency is known and has been disclosed for other applications, its peculiar advantages for the solution of the present problem of using glue as a substitute for mechanical clamps are herein for the first time disclosed. Its remarkable efficiency over the previously described conductive heating will be clear from the following comparison.

Time of clamping

	Minutes	Seconds
Without spot heating.....	360	21,600
Conducted heat spot gluing.....	15	900
Radio frequency spot gluing.....	0.17	10

In other words, with conductive heating, the clamping time has been cut to $\frac{1}{24}$ of the original period, and with radio heating it has been cut to $\frac{1}{2160}$ of the original time and $\frac{1}{90}$ of the time required by the conduction method. Similar results may be obtained with other cold-setting glues.

It will be seen that the method of the present invention represents an important improvement in the art of edge gluing lumber and the like since it enormously increases the output from the clamping apparatus. It is, of course, understood that longer boards can be clamped with equal speed by simply supplying apparatus that will heat the additional local areas required for proper clamping together of longer parts. It will also be understood that the locations of the spots to be heat-set in order to have them act as clamps are exactly the same as the locations where mechanical clamps would be required, since the heat-set spots perform exactly the same function as the mechanical clamps. Therefore, if the assembly could be adequately clamped together by

a single clamp, one heat-set spot would be adequate, or if two, three, six, or any other number of mechanical clamps would be required, apparatus can be provided to heat-set a corresponding number of spots. By appropriate modification of the apparatus, sticks can of course be glued successively to previously glued assemblies so as to build up boards of any desired width. Those skilled in the art may readily apply the method of the present invention in a wide variety of ways and with various types of apparatus especially designed to make particular products.

Although the use of my new method is particularly advantageous in edge gluing lumber, any surfaces which are adapted for gluing by the use of clamps which only press against a minor part of the total surface area may be glued by this method.

The invention, therefore, provides a method of uniting surfaces with a cold-setting glue by maintaining gluing pressure over the entire surface to be glued by external clamping means while simultaneously heat-setting a portion of the surface and then releasing the clamps and allowing the remainder of the surface to cold-set while the gluing pressure is maintained by the adhesion of the heat-set area, with the important advantage that the actual time when the clamps are used to hold together the assembly can thus be enormously reduced since, by the methods described, adequate heat-setting of the local areas can be obtained in a small fraction of the time that is required to develop the cold-set bond.

It will also be understood that, while the invention derives from the principle of heat-setting one or more small local areas or spots in a surface to be glued, which areas or spots are effective to clamp the entire assembly together during the period in which the remainder of the glue-spread area is cold-setting, the method of heating the local areas is theoretically immaterial. In the foregoing description in Example 1, it has been shown that a considerable advantage can be gained by heating the local areas by heat conducted thereto from an outside source. However, from the practical standpoint, I find that the gain in speed and efficiency of heating by the use of selective internal heating of the glue line by using high frequency radio apparatus as described in Example 2 is so great that the radio method is to be preferred in the majority of applications.

I claim:

1. The method of uniting surfaces with a cold-setting glue whose rate of setting is accelerated by heat, which comprises applying external gluing pressure, maintaining said gluing pressure over the entire surface to be glued while simultaneously heat-setting a portion of the surface and then releasing the external pressure and permitting the remainder of the surface to cold-set while gluing pressure is maintained by the adhesion of the heat-set area.

2. In gluing with a cold-setting glue whose rate of setting is accelerated by heat, the method of shortening the period of maintaining externally applied gluing pressure which comprises clamping the surfaces together for a relatively short time while simultaneously heat-setting a portion of the surface and then releasing the externally applied pressure and permitting the remainder of the surface to cold-set while gluing pressure is maintained by the adhesion of the heat-set area.

3. In gluing with a cold-setting glue whose rate of setting is accelerated by heat, the method of

shortening the period of maintaining externally applied gluing pressure which comprises clamping the surfaces together, with glue interposed therebetween, for a relatively short time while simultaneously conducting heat to a portion of the interposed glue from an external source to heat-set said portion and then releasing the externally applied pressure and permitting the remainder of the glue to cold-set while gluing pressure is maintained by the adhesion of the heat-set area.

4. In gluing with a cold-setting glue whose rate of setting is accelerated by heat, the method of shortening the period of time of maintaining externally applied gluing pressure, which comprises clamping the surfaces together for a relatively short time with glue interposed therebetween, simultaneously inducing molecular friction within a limited portion of the glue by subjecting the same to high frequency oscillations from a radio frequency source, thereby to heat-set said portions, and then releasing the external clamping pressure and permitting the remainder of the surface to cold-set while gluing pressure is maintained by the adhesion of the heat area.

5. The method of edge gluing lumber with a cold-setting glue whose rate of setting is accelerated by heat, which comprises applying external gluing pressure, maintaining said gluing pressure over the entire glue line surface for a relatively short time while simultaneously heat-setting a limited portion of the surface and then

releasing the external clamping pressure and permitting the remainder of the surface to cold-set while gluing pressure is maintained by the adhesion of the heat-set area.

6. The method of edge gluing lumber with a cold-setting glue whose rate of setting is accelerated by heat, which comprises maintaining externally applied gluing pressure over the entire coated edge surfaces of the lumber for a relatively short time, simultaneously conducting heat to a limited portion of the edge surfaces from an external source to heat-set the glue at said portions, releasing the externally applied pressure and maintaining gluing pressure by the heat-set portion, and cold-setting the remainder of the surfaces while said gluing pressure is so maintained.

7. The method of edge gluing lumber with a cold-setting glue whose rate of setting is accelerated by heat, which comprises maintaining externally applied gluing pressure over the entire glue coated edges of the lumber for a relatively short time, inducing sufficient molecular friction within a portion of the glue on the edges of the lumber by high frequency oscillations transmitted thereto from a radio frequency source to heat-set said glue, releasing the externally applied pressure, and cold-setting the remainder of the surfaces while gluing pressure is maintained by the adhesion of the heat-set area.

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