March 31, 1953 F. H. GILLESPIE ET AL 2,633,166

GLUING MACHINE

Filed July 26, 1946 4 Sheets-Sheet 1

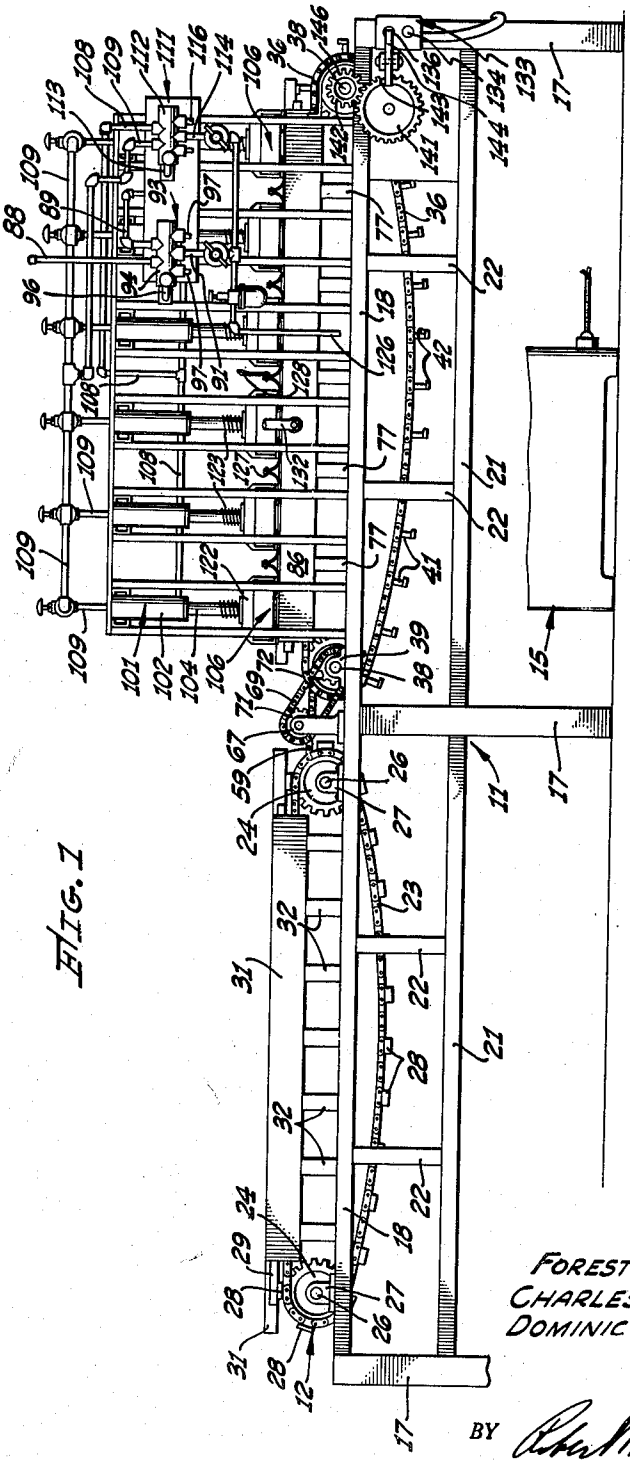


FIG. 1

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GLUING MACHINE

Filed July 26, 1946 4 Sheets-Sheet 2

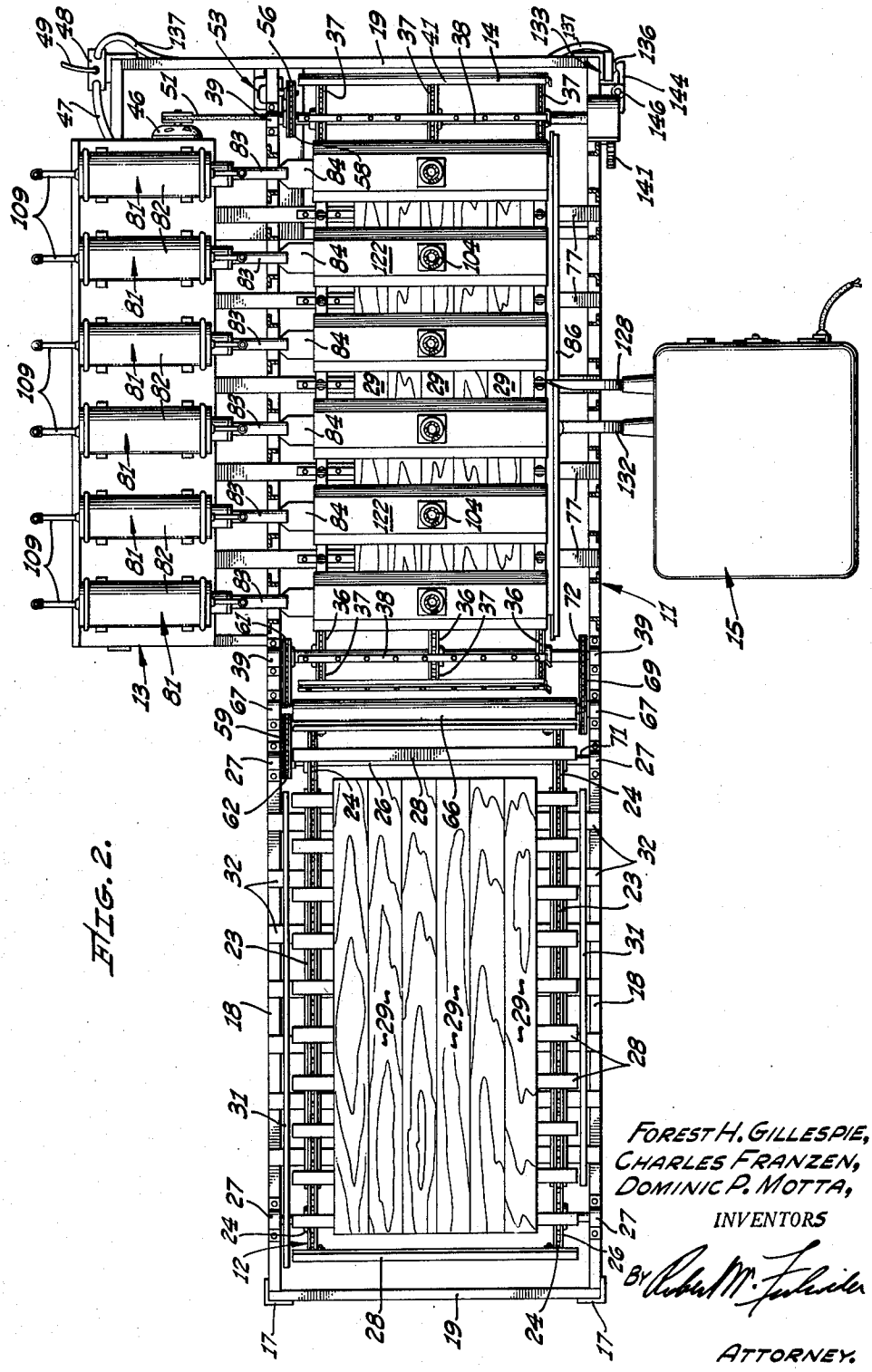


FIG. 2.

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GLUING MACHINE

Filed July 26, 1946 4 Sheets-Sheet 3

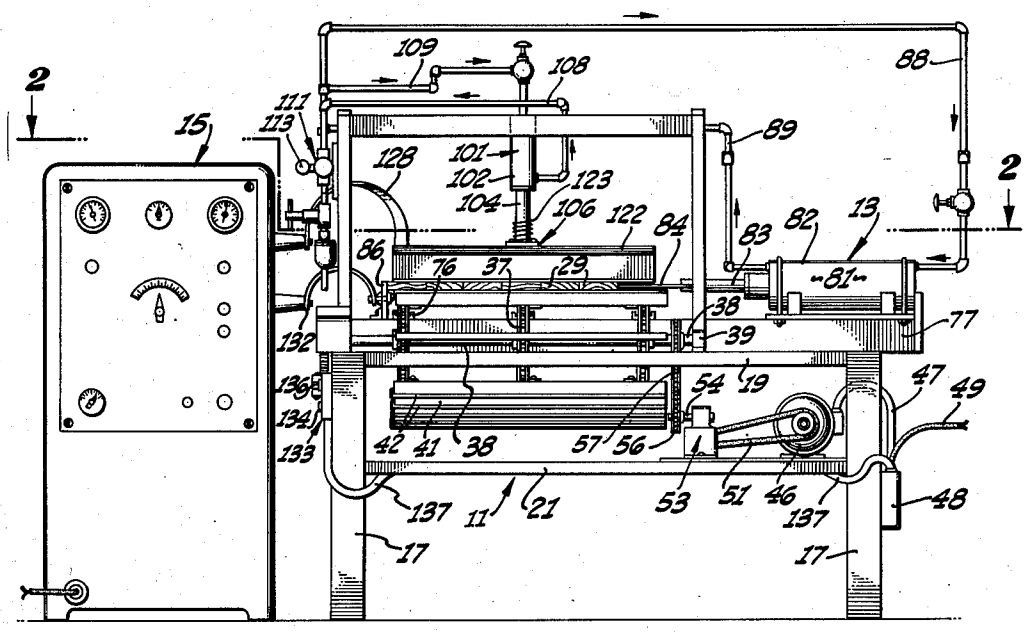


FIG. 3.

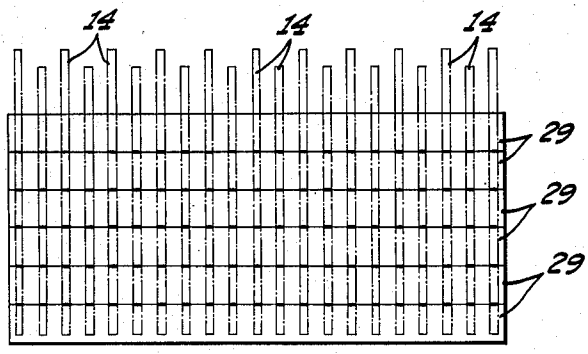


FIG. 4.

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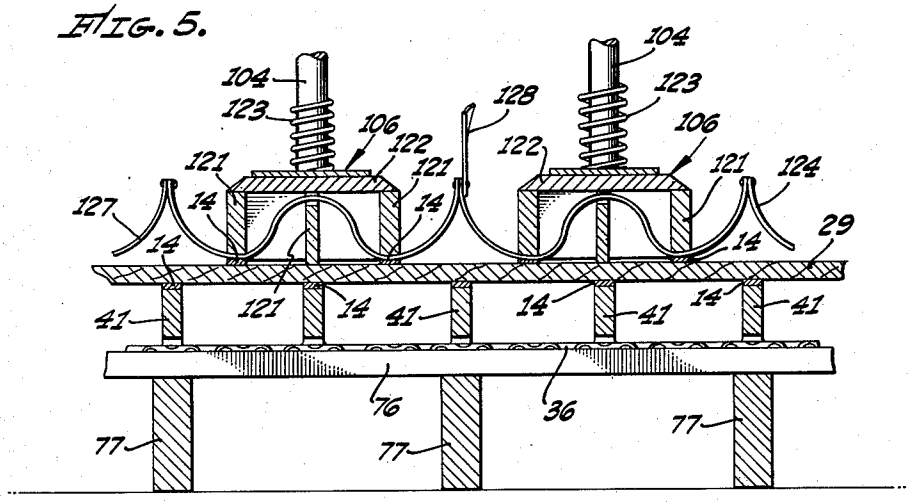
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March 31, 1953 F. H. GILLESPIE ET AL 2,633,166

GLUING MACHINE

Filed July 26, 1946 4 Sheets-Sheet 4

FIG. 5.



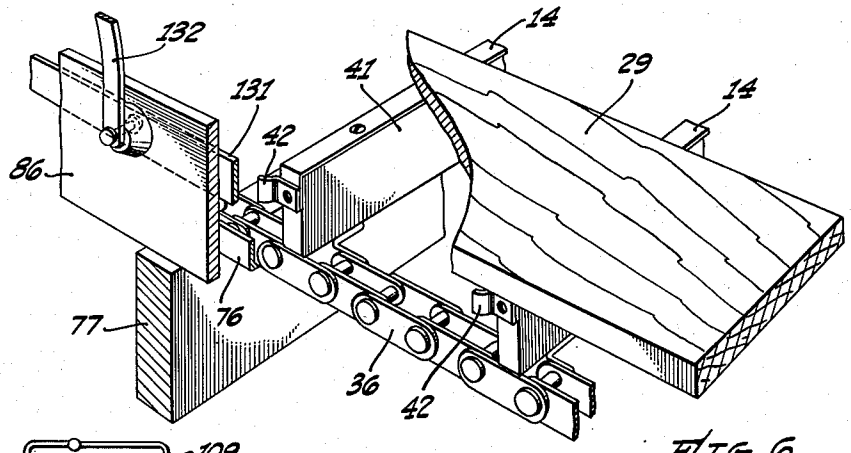


FIG. 6.

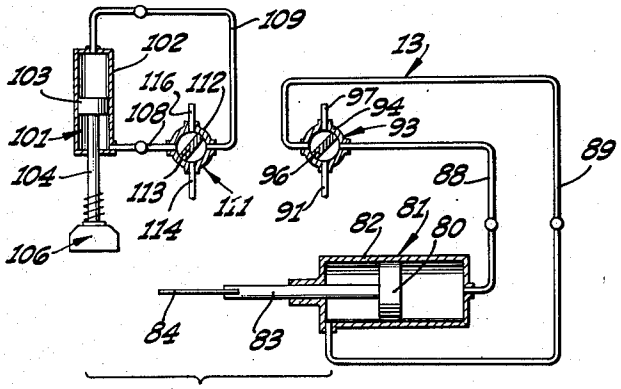


FIG. 7.

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UNITED STATES PATENT OFFICE

2,633,166

GLUING MACHINE

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Application July 26, 1946, Serial No. 686,520

2 Claims. (Cl. 144—281)

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The present invention relates to gluing machines in general and particularly to a gluing machine adapted to secure together a plurality of narrow strips of wood to form a relatively wide panel or board and in a time period only a fraction of that ordinarily required for such an operation. More specifically, the invention comprises a panel gluing machine in which the gluing together of relatively narrow strips of wood is accelerated by means of electrostatic heating to form relatively large panels and in a period of time which is but a fraction of the time normally required for the glue to set.

In the manufacture of furniture and other articles of wood it has been found both desirable and economical to manufacture large area panels from narrow wood strips. By the older method a suitable adhesive or glue is placed upon adjacent surfaces which are then clamped together and set away to dry over an extended period of time. The time required for the glue to set was a matter of hours and depended upon the temperature of the ambient atmosphere. This operation required large drying rooms and the continuous use of clamps until the glue had set. In certain installations conveyor racks were provided upon which the clamped panels were suspended and by which they were carried to and from the drying room. To speed the operation heating means were also provided in some installations to raise the drying temperatures, a step which served to increase still further the cost of the operation.

The apparatus constructed in accordance with the present invention eliminates the use of clamps, heating rooms and conveyors and effects a sufficient adhesion of the glue by the application of electrostatic heating for a period of a fraction of a minute to cause the strips to adhere without further assistance.

The drying of the glue to effect the substantial instantaneous adhesion of the wooden strips is, according to the present invention, effected electrostatically. There are a plurality of electric heating methods. The simplest comprises conduction in which the heat is derived from energy dissipated by the passage of electrical current through a resistance. To use such heating means adjacent a wooden element, however, would produce scorching of the wood if the temperature were raised to a point sufficiently high to dry the glue instantaneously or substantially instantaneously. Where the article to be heated is metallic, use may be made of induction heating in which a magnetic field is set up by

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an induction coil near the article to be heated producing, if the field is oscillatory, eddy currents in the article which are dissipated as heat energy. This method of heating is not available in the use of wood which is a non-conductor.

Still another type of heating is known as electro-magnetic heating in which energy in the form of electro-magnetic radiation is absorbed in a body and converted thereby into heat. Infra-red heating is a special form of this type of heating since the incandescent filament of the bulb radiates electro-magnetic energy in the infra-red wave lengths, which are absorbed by the body to be heated. This type of energy is absorbed by both conductors and dielectrics.

A further type of heating, and this is the type which is used in the present invention, comprises electrostatic or dielectric loss heating and is operative by virtue of the fact that most materials when used as dielectrics are imperfect and so have dielectric losses. When a material, such as wood for example, is placed between the plates of a capacitor as a dielectric, it will be heated as the electrical dielectric loss is converted into heat. In such heating, frequencies as high as 50 megacycles are common.

In the apparatus comprising the present invention, use is made of the electrostatic method of heating and means are provided by which the wood strips to be glued are advanced on a conveyor into the presence of the heating means, at which point they are compressed and forced together by pressure exerted from all sides. The creation of intense heat therein for a limited period of time by positioning plates connected to a source of high frequency current upon the opposite sides thereof, effects a substantially instantaneous drying of the glue, or at least of certain portions thereof and produces what can be termed "spot gluing." Upon release of the pressures and the removal of the panel, the multiplicity of spots which are glued provide a sufficient holding force to secure the entire panel together and it may be transported without particular care and stacked and permitted to dry completely without further special attention.

It is an object of the present invention to provide a new and improved gluing machine for wooden panels in which a multiplicity of relatively narrow wooden strips are glued together by the application of electrostatic heat over an extremely short time interval to effect sufficient adhesion as to permit the panel to be removed and treated as a unit without special care.

It is a further object of the invention to pro-

vide a gluing machine constructed and arranged as to feed successive groups of relatively narrow wooden strips into the presence of clamping and electrostatic heating means to produce substantially instantaneous gluing of the strips to an extent sufficient to eliminate the necessity for subsequent retaining clamps and heated drying rooms.

These and other more specific objects will appear upon reading the following specification and claims upon considering in connection therewith the attached drawings to which they relate:

Referring now to the drawings in which a preferred embodiment of the invention is disclosed,

Figure 1 is a side elevation of a machine constructed in accordance with the present invention; and

Figure 2 is a horizontal section through the machine looking in the direction of the arrows upon the line 2—2 of Figure 3; and

Figure 3 is a front view of the machine; and

Figure 4 is a diagrammatic showing of the intersections of the plates or contacts and the planes of the joints of the wooden strips and shows the points at which maximum adhesion is effected; and

Figure 5 is an enlarged partial section through the contacts of the electrostatic heating means and shows a panel in place therebetween; and

Figure 6 is a view in perspective showing the panel supporting conveyor, with its movable contact plates; and

Figure 7 is a diagrammatic showing of the valve-controlled pressure-acted clamping means.

The panel gluing machine constructed in accordance with the present invention comprises five main or principal parts which may be called the supporting base or frame, indicated generally in the drawings by the reference character 11; the conveyor system indicated generally in the drawings by the reference character 12; the pneumatic clamping means, indicated generally by the reference character 13; the high frequency drying means, including the high frequency current generating unit and the contacts, indicated generally by the reference characters 14 and 15; and the semi-automatic control means.

The relationship of and the cooperation between these various parts will now be described.

The frame

The frame of the unit is shown most clearly in Figures 1, 2 and 3 and is seen to comprise an elongated table formed with supporting legs 17 between which extend longitudinal top elements 18 and transverse top elements 19. The forward end of the table is made wider than the rearward part to provide supporting means for the horizontal clamping means later to be described. To insure rigidity and relatively great strength, horizontal and vertical brace members 21 and 22 are provided between the legs and below the top members 18 and, in the preferred form, all of the elements are fabricated of metal. The base or frame is relatively strong being intended and adapted at its forward end to support working parts weighing several hundred pounds. The entire unit is preferably secured fixedly in place upon a supporting floor to reduce vibration and possible dislocation.

The conveyor system

The conveyor system is shown clearly in Figures 1, 2, 3, 5 and 6 and comprises a rear, or feeder unit, and a forward or gluing unit. These units form in fact one conveyor being aligned and interconnected to travel at the same rate of speed. Referring first to the feeder unit, it is seen to be mounted upon the top of table 11 and to comprise a pair of parallel spaced endless chains extended longitudinally of the machine adjacent the frame top members 18 and carried by sprockets 24. The latter are fixed upon shafts 26 rotatably mounted in bearings 27 secured on members 18.

A multiplicity of cross pieces or support elements 28 are secured to chains 23 at spaced intervals to form the supporting surface of the conveyor unit and, as is clearly shown in Figure 2, provide a flat bed upon which a plurality of parallel wooden strips 29 are adapted to lie. Side rails 31 extend adjacent the ends of the elements 28 to prevent accidental lateral displacement of pieces 29, being connected to and supported on the frame top elements 18 by a plurality of upright members 32.

The feeder conveyor unit, as the name indicates, is a feeding unit, but it also serves as the initial assembly point at which the strips 29 to be glued together into a panel are assembled with their adjacent edges coated with an adhesive. At the proper time the unit functions, as will be described, to advance the strips on the forward conveyor unit where the heat treatment takes place.

The forward conveyor unit also comprises longitudinally extending spaced chains, here indicated by the reference character 36. Each chain, and there are three, is again carried at its forward and rearward ends by a sprocket 37 fixedly mounted upon a rotatable shaft 38. The latter is supported at its ends in bearings 39 mounted on the top of frame side members 18. As in the case of the rear or feeder conveyor, transverse cross pieces or elements, indicated at 41, are spaced at equal intervals along the chains to form a bed or support surface. In the present case, however, for reasons which will be apparent, the upper or supporting edge of each element 41 is provided with a metallic electrical conductor, strip, or plate 14 connected at one end to an electrical wiper or brush 42.

To drive the conveyors there is provided an electric motor 46 positioned below the top of the frame 11 on the level of braces 21, 22 and supplied with current by a conduit 47 connected to a switch 48 which may be of the solenoid-controlled type. The incoming current to the switch 48 enters by the conductor indicated by the reference character 49. Power from the driving motor 46 is transmitted through an endless belt 51 to a speed reducing unit 53 which includes a slow speed rotary shaft 54 carrying a sprocket 56. A power transmitting chain 57 extends upwardly from sprocket 56 to a second sprocket 58 positioned upon the conveyor shaft 38 at the front of the machine. Energization and rotation of the motor is effective to rotate that shaft at reduced speed and, as all three chains 36 are all connected to sprockets 37 carried by front shaft 38, it is clear that its rotation will effect the travel of the front conveyor.

To transmit the actuating force from the front to the rear or feeder conveyor a power transmitting chain 59 is connected, as shown in Figures 1 and 2, between sprockets 61 and 62 positioned respectively upon the shaft 38 at the rearward end of the front conveyor and upon the shaft 26 at the forward end of the feeder conveyor. Actuation of the front conveyor is automatically effec-

tive through the chain 59 to actuate the rear conveyor and at the same rate of speed, sprockets 61 and 62 being of the same diameter. As the forward and rear conveyor units are spaced slightly a supporting roller 66 is provided therebetween. The latter is supported at its ends in bearings 67 upon frame side elements 18 and is positively driven by a chain 69 which extends from a sprocket 71 on the roller shaft to a driving sprocket 72 on the adjacent shaft 38 of the front conveyor. Upon energization of the motor, because of the interconnections present, the front conveyor unit, the rear conveyor unit, and the roller 66 are simultaneously actuated.

As will be explained subsequently a downward clamping pressure is exerted upon the wooden strips 29 when positioned upon the forward conveyor unit and to withstand this pressure, reinforcing means are provided for the front conveyor chains 36. These means take the form of elongated rigid metallic channels 76 in which the upper half of each front conveyor chain 36 slides. Channel members 76 are themselves supported by spaced transverse wooden beams or supports 77 the ends of which rest upon the longitudinal frame elements 18.

It is the purpose of the forward and rear conveyors which have been described to feed the panel elements into position for heating, to support it during the heat treatment and in the presence of considerable pressures forcing the elements together, and then to discharge the treated panel from the machine. The means by which the clamping pressures are exerted during the heat treatment will now be described.

The clamping means

With the narrow wooden strips 29 positioned upon the forward conveyor in position to be heat treated, the clamping means perform their function of bringing the elements tightly together to force the adhesive positioned upon adjacent surfaces into the interstices of the wood and to expel the excess. Turning first to the horizontal or lateral compression means, they are seen to comprise a bank of pneumatic rams 81 mounted upon the widened forward portion of table 11 at the side of the front conveyor and in substantial horizontal alignment with the top surface thereof. Each ram comprises as shown in Figure 7, a fixed cylinder 82 slidingly seating a piston 80 and from which extends a piston rod 83. The latter carries at its forward end an abutment element 84 adapted to make contact with the outside wooden strip 29 and to force it against the strip adjacent thereto. At the opposite side of the conveyor is a rigid abutment or side wall 86 positioned upon the cross beams 77 and having a height sufficient to obstruct the lateral displacement of the elements 29 under the horizontal force exerted by the rams 81.

The rams 81 are identical and are pneumatically operated. Air conduits 88 and 89 connect to the opposite ends of each cylinder 82, their own opposite ends connecting to a source of pneumatic pressure comprising a conduit 91, through a manually controlled valve 93. The latter includes a casing 94 and a movable valve element 96. In Figure 7, valve 93 is shown diagrammatically with movable element 96 positioned so that air under pressure passes from conduit 91, through the casing 94 and conduit 88, and into the cylinder 82 to exert a pressure upon one side of the piston 80. Movement of the piston under this pressure will effect the exhaust of air from cylinder 82 upon the opposite side of piston 80. The exhausted air passes through the conduit 89 into valve casing 94 and therefrom through the exhaust pipe 97. Manual reversal of the position of valve element 96 connects conduit 89 to the pressure source, effects movement of the piston 80 in the opposite direction, and exhausts air from the cylinder 82 through conduit 88. The manual operation of the valve 93 is seen to control the direction of movement of the ram piston 80 and enables the operator to cause the abutment 84 to move into abutting and pressure exerting contact with the panel elements 29, or to be withdrawn therefrom.

In addition to the exertion of a transverse compressing force by the rams 81, it is desirable also that a vertical force be exerted to maintain the elements in alignment and against any possible buckling and also to move the upper contacts 14 downwardly into contact with the panel. To effect these results, a plurality of identical vertical rams 101 are provided, each comprising a casing 102 housing a slidable piston 103 from which extends a piston rod 104 carrying at its lower end an abutment head 106. As in the case of rams 81, conduits, here indicated by the reference characters 108 and 109, extend from opposite ends of the cylinder 102 to a manually-controlled valve indicated generally at 111 and which includes a casing 112 and a manually movable valve element 113. A conduit 114, leading to a source of air pressure, connects to the valve casing 112 as does one or more exhaust outlets 116. With the valve element 113 positioned as shown in Figure 7, the piston 103 is forced downwardly by the pressure of air from the conduit 109, the air within the lower portion of the cylinder and below the piston being forced therefrom through conduit 108, valve chamber 112 and outlet 116. Upon reversal of the position of valve element 113 as to connect pressure conduit 114 to conduit 108, the direction of piston movement is reversed.

The abutment head 106 at the lower end of the piston rods 104 of each ram 102 comprises three laterally extending spaced abutment elements or pieces 121 connected by a header 122 directly secured to the lower end of rod 104. The upper contact elements 14 are secured to the lower faces of the pieces 121. A coil spring 123 encircles each piston rod 104 above the abutment head 106 and acts as a shock absorber and to limit the upward movement of the head under piston actuation.

The various rams 81 act in synchronism as do the various rams 101, making it possible for the functionally similar conduits leading thereto to be joined into a single conduit leading to the valve chambers as shown in Figures 1 and 3. Also, it is possible for a single incoming source of air pressure in a conduit 126 to be connected to both of the pressure conduits 91 and 114 leading to valves 93 and 111, respectively. Because of this interconnection and relationship, the operation of a single set of valves 93 and 111 effects the joint and synchronous operation of all rams 81 and all rams 101 respectively, the rams 81 preferably being actuated first.

The high frequency heating means

It has previously been described that contacts or plates 14 are carried by the cross pieces 41 of the front conveyor unit and by the side elements 121 of the abutment head 106, as shown most clearly in Figure 5. The strips of wood

29 which are to be glued together to form a single unitary panel are positioned during the heating operation upon the cross pieces 41 and are subjected to the vertical and horizontal compression by the rams 81 and 101 as described under the preceding title. Were the strips to be held for a sufficient length of time, the glue between the strips would set without more being done but clearly this would result in the tying up of the complete machine for a matter of hours. This time interval is reduced to a matter of seconds by the provision of high frequency current in the contacts 14 in contact with opposite sides of the strips. The contacts, which extend perpendicularly across the strips in the manner illustrated diagrammatically in Figure 4, have impressed upon them a high frequency current to heat the glue electrostatically. The current impressed may be in the range of 50 megacycles and is conducted to the upper contacts 14 by means of a flexible buss bar 127 which is itself connected through a conductor 128 to the high frequency current-generating unit 15. The lower contacts 14, being movable, are connected at their ends, as previously described, to wiping brushes 42 which make contact with a stationary buss bar 131 carried by the abutment or side wall 86. The current is conducted to the latter from the generating unit 15 through a conductor 132.

High frequency current generating unit 15 may be of a commercial type and does not constitute the essence of the present invention. It is adapted to be supplied with line voltage current from an external source at ordinary 50 or 60 cycles and to convert that current into current of extremely high frequency through the use of vacuum tube circuits for the purpose described. The unit is preferably contained within a single casing and may well be positioned adjacent the gluing machine proper, as illustrated in Figures 2 and 3. Suitable controls may be provided by which the unit is energized when initially placed into operation and deenergized at the end of the working period.

Control of the feeding operation

To simplify the duty of the operator, means are provided which render it necessary only to push a button in order to displace the panel which has just been formed and to advance into operative position the strips to be treated. These means comprise a master control switch, indicated generally at 133, including a manually operable starting button 134 and an automatic stop or cut-out button 136. Switch 133 is connected by means of conductors positioned within a conduit 137 with switch 48 which may, as previously indicated, be of the solenoid type.

To actuate master switch 133 automatically, a rotatable gear 141 is mounted upon the side of frame 11 adjacent its forward end and conveyor shaft 38 thereabove is connected therewith by means of a pinion 142 which it carries. Gear 141 comprises a rotatable cam by virtue of the presence of a sloping cam element 143 positioned on its side near its periphery. Element 143 is so located and proportioned as to ride under and lift the end of a lever 144 which is pivoted centrally at 146 on the frame 11 so that its opposite end extends into operative abutting contact with the stop or cut-out switch button 136. The purpose of the cam is to effect the pivotal movement of the lever as to actuate stop button 136 and thereupon deenergize the driving motor 46 upon gear 141 having made one complete revolution. The relationship is such that gear 141 makes one complete revolution upon the advance of the conveyor system sufficiently to move the strips 29 from the feeder conveyor onto the forward conveyor and into operative position.

Operation

In the operation of the present invention the wooden strips 29 are first covered with glue upon their edges and are laid parallel upon the feeder conveyor at the rear of the machine as shown in Figures 1 and 2. The button 134 is then pushed by the operator, resulting in the energization of the motor 46, which drives the conveyors to move the panel forwardly into operative position below the abutment heads 106. Upon reaching this position the cam gear 141 has rotated through 360° and the cam element 143 causes the lever 144 to pivot to actuate the push button 136 whereupon the motor is deenergized and the conveyor movement stopped.

As will be noted from an examination of Figure 5, the conveyor movement is stopped in such relative position of the upper and lower bars or contacts 14 that each contact in one group (upper or lower) lies substantially midway between two adjacent bars of the other group. Thus, it will be seen that when the upper contacts are pressed downwardly against the strips 29, the spans of the latter supported on two adjacent conveyor bars 41 are bent downwardly somewhat, the amount of bending being dependent upon the degree of pressure exerted by the upper contacts and the longitudinal spacing of the contacts. As can be seen in the drawings, the spacing betwen adjacent spacer bars is several times the thickness of the planks so that an appreciable bend of the strips 29 is possible without excessive clamping pressure.

Accordingly, if one of the strips 29, as often happens, is slightly thicker than the others, such thicker strip is bent downwardly, permitting each contact 14 to make a uniform and continuous contact across the panel, thus contacting each of the several glue joints.

The high frequency generating unit 15 has previously been energized by the usual means and is ready to perform its heating function upon the bringing into operative juxtaposition of the contacts 14. Before this is done, however, the operator manually turns valve element 96 to the position shown in Figure 7, thereby causing pistons 80 in each of the rams 81 to advance with the abutment elements 84. The latter force the wooden strips 29 together as the strip upon the outer edge is forced against the side wall or abutment 86. The operator then positions manually operable valve element 113 in the position shown in Figure 7, thereby causing air to pass through pipe 109 into the top of cylinder 102 to force the piston 103 downwardly. This operation takes place simultaneously in each of the pneumatic rams 102 and the plungers 104 force the abutment heads 106 into contact with the underlying wooden strips, that is, into the position shown in Figure 5.

The relationship then existing between the contacts or plates 14 is such that the retention of the heads in the lowered position for a fraction of a minute effects the heating and drying of the glue by means of electrostatic heating. The frequency of the current is such as to effect primarily the drying of the glue and such drying is believed to take place with maximum effectiveness at the lines of intersection of the con-

tacts and of the glued surfaces as indicated in Figure 4. Upon the elapse of the predetermined time period, a matter of seconds and less than one minute, the operator changes the position of valve element 113 to permit air to be directed from the inlet pipe 114 through pipe 108 to lift the piston 103 in each of the rams 101. Heads 106 are thereupon carried upwardly, the coil springs 123 serving as bumpers to prevent the piston striking the upper end of the cylinder.

With the abutments 106 raised, the operator then reverses the position of valve element 96 to cause air to be forced through conduit 89 into the forward end of cylinder 82. Thereupon the pistons 80 move the abutment elements 84 from the panel which is now, so far as any reasonable separating force is concerned, a unitary structure. Thereupon the operator again energizes motor 46 by pushing button 134 to cause a repetition of the feeding operation previously described which this time includes the advance of the treated panel out of the machine, a suitable receiver or attendant disposing of the panel.

While the particular apparatus herein shown and described in detail is fully capable of attaining the objects and providing the advantages hereinbefore stated, it is to be understood that it is merely illustrative of the presently preferred embodiment of the invention and that no limitation is intended to the details of construction or design herein shown other than as defined in the appended claims.

We claim:

1. In apparatus for edge gluing a plurality of longitudinally disposed planks positioned in side by side relationship, into a unitary panel, clamping and glue setting means comprising in combination: a first group of transverse bars uniformly spaced apart by several times their width and disposed in a common plane; a second group of transverse bars spaced apart as said first bars, and disposed in a common plane opposed to, and substantially parallel to said first bars; means to support said second group of bars for longitudinal movement in said second plane to carry planks supported thereon into and out of the space between said bars; means to halt the movement of said second bars in a position thereof wherein a bar in said second group lies longitudinally intermediate two adjacent bars in said first group; and pressure means connected to said first group of bars to urge the same toward said second plane to slightly bend planks lying in said space between said planes.

2. In apparatus for edge gluing a plurality of longitudinally disposed planks positioned in side by side relationship, into a unitary panel, clamping and glue setting means comprising in combination: a first group of transverse bars uniformly spaced apart by several times their width and disposed in a common plane; a second group of transverse bars spaced apart as said first bars, and disposed in a common plane substantially parallel to said first plane; means to support said second group of bars for longitudinal movement in said second plane to carry planks supported thereon into and out of the space between said bars; drive means connected to said support means to move said bars as aforesaid; means synchronously connected to said drive means to halt the movement of said second bars in a position thereon wherein a bar in said second group lies longitudinally intermediate two adjacent bars in said first group; and pressure means connected to said first group of bars to urge the same toward said second plane to slightly bend planks lying in said space between said planes.

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