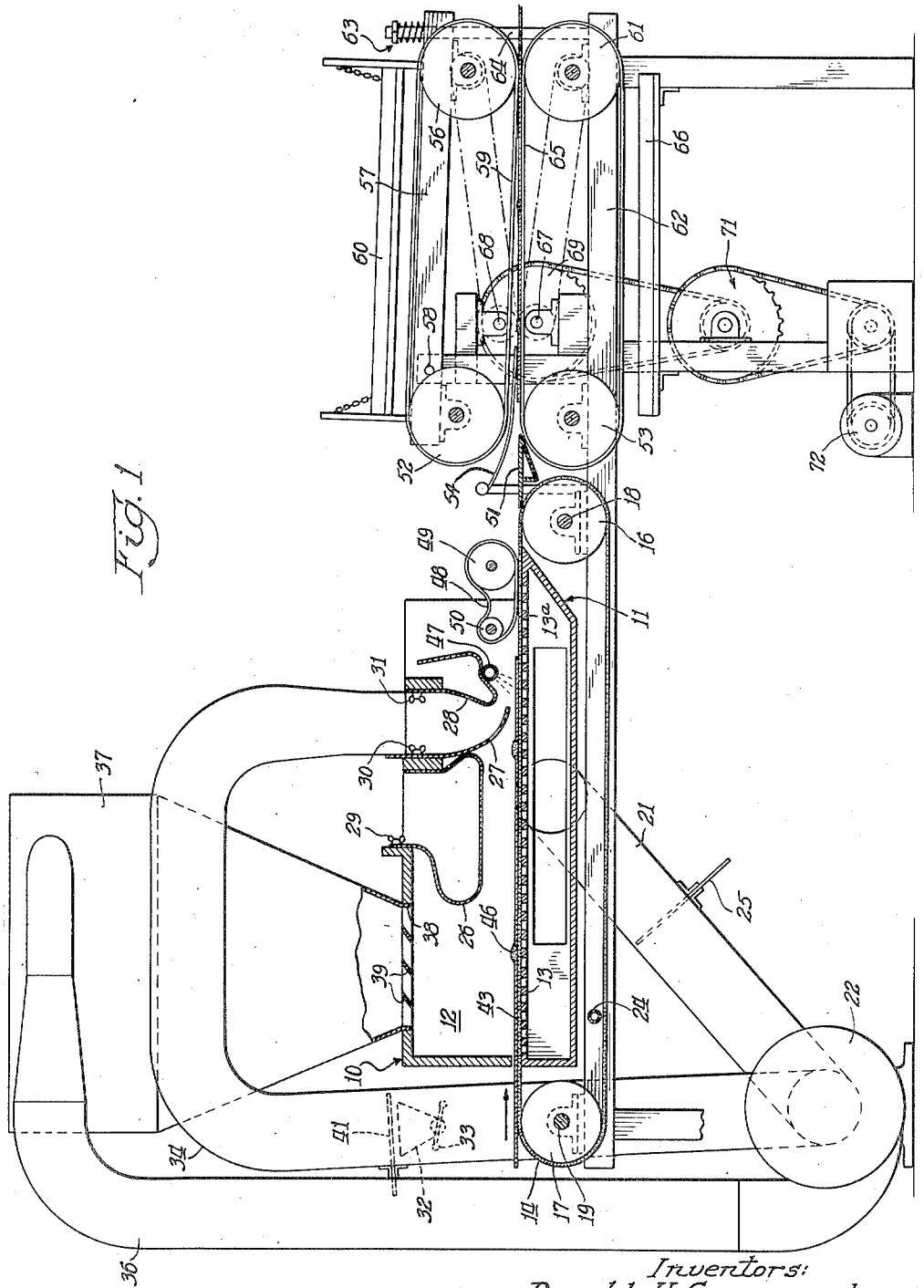
Nov. 13, 1956 D. H. GRANGAARD ET AL 2,770,556

METHOD OF PATCHING AN OPENING IN A PLANE MEMBER

Filed Jan. 22, 1953 2 Sheets-Sheet 1

Fig. 1



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METHOD OF PATCHING AN OPENING IN A PLANE MEMBER

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Fig. 6

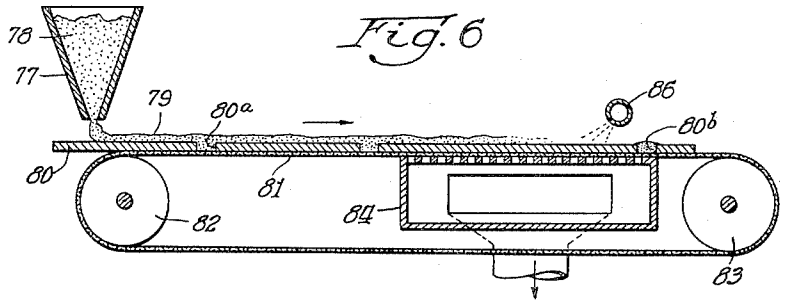


Fig. 7

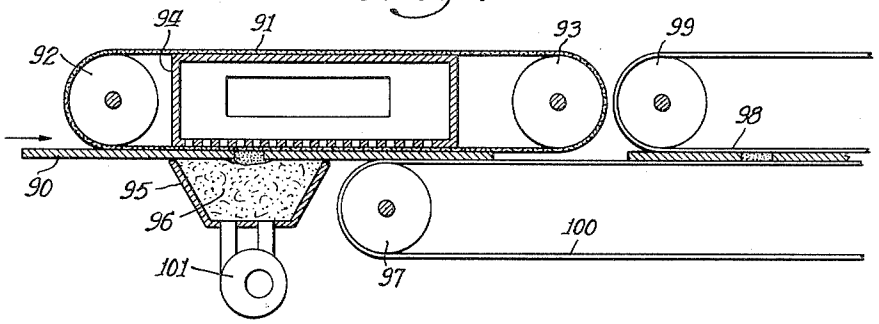


Fig. 2

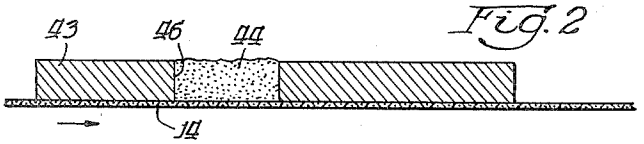


Fig. 3

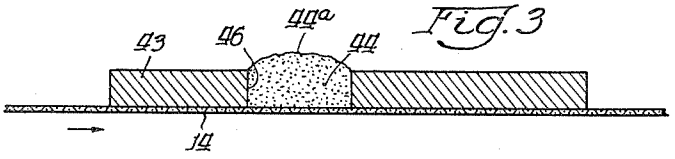


Fig. 4

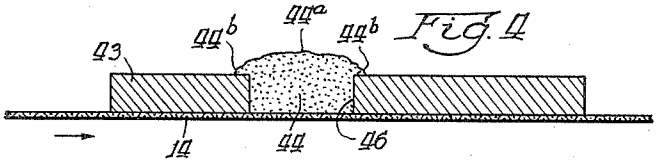
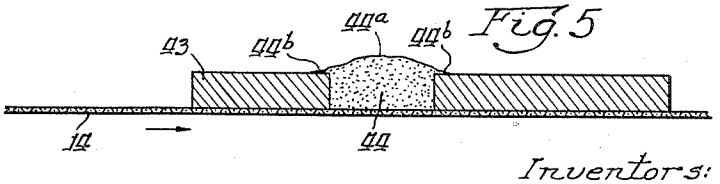


Fig. 5



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2,770,556

METHOD OF PATCHING AN OPENING IN A PLANE MEMBER

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Application January 22, 1953, Serial No. 332,694

3 Claims. (Cl. 117—2)

The present invention is concerned with a method and apparatus for patching surface discontinuities such as holes, splits, and cracks in wood veneer.

As wood veneer strips are cut from logs, a wide variation in quality occurs in the strips produced, even in strips cut from the same log. Some lengths of veneer will be found to have practically no surface defects, and these strips are immediately suitable as facing sheets for the manufacture of plywood of high quality. Other strips, however, have so many knotholes, splits, and cracks that they are rendered practically useless as surface veneers for the better grades of plywood and in many instances even for cross-banding, and consequently command only a far smaller price than the strips free from such defects.

The Douglas Fir Plywood Association grades Douglas fir plywood veneer into four classes. Type A veneers are those which have a smooth surface free from knots, splits, pitch pockets, and other open defects. Type B veneers are those which have a solid surface and are free of open defects. They may contain some neatly made patches and small amounts of discoloration. Knots up to one inch in diameter may be present if the knots are sound and tight. Similarly, tight splits or a slightly rough or ruptured grain and minor sanding and patching defects may be found in this veneer. Both type A and type B veneers are considered suitable for surfacing use in the manufacture of the better grades of plywood.

The next lower grade, type C, are those which may contain knotholes up to one inch in diameter, pitch pockets not wider than one inch, and splits no wider than 3/16 inch, provided the splits taper to a point. Such veneers may also have worm or borer holes whose dimensions may be no greater than 5/8 inch by 1½ inches.

The lowest grade, type D, are those which may contain knotholes up to 2½ inches in diameter, and pitch pockets up to 2 inches by 4 inches. Such veneers may also contain splits, provided the splits taper to a point. The maximum width of such splits is designated as ½ inch if the split extends to a quarter of the panel length, ¼ inch if it extends to a half of the panel and 3/16 inch if it extends the full length of the panel. C and D veneers are used primarily for the internal plies, except for low grade products.

As an overall average, Douglas fir plywood veneers cut in the United States average about 25 percent type A, 5 percent type B, 30 percent type C, and 40 percent type D. Thus, more than half of the veneers are undergrade for many purposes.

Veneer strips require patching for reasons other than improvement in the appearance of the veneer. For example, in the manufacture of plastic surfaced plywood, of the type used in concrete form panels, or plywood which is to be covered with a masking sheet, it is necessary that the outermost ply to which the plastic or the masking sheet is applied be flat and free from surface discontinuities. Hence, where such plywood specialties are manufactured, it has been necessary to specify that the outermost plies consist of type A or type B veneer. Naturally, this raises the cost of these products because one must supply a high grade veneer of good appearance for a use in which appearance is not of primary importance. This practice depletes the supply of grade A and B veneers for uses where the use of these grades is essential.

The patching of veneers has heretofore been carried out as a more or less manual operation requiring the services of reasonably skilled workmen. In one method commonly used for patching veneers, surface discontinuities such as knotholes are punched out of the sheet by means of a machine leaving a circular hole in the sheet. This hole is then plugged with a so-called "cookie patch" which consists of a circular piece of veneer, this patch being wedged into the previously cut hole. This type of patching was not always effective to present a completely flat surface and had the distinct disadvantage that it required an operation which was both costly and time consuming.

Somewhat better patches are obtained with the so-called "boat patch" method, in which the veneer surrounding the defect is sawed out in the shape of a boat, i. e., an elongated, doubly convex shape having tapered ends. The boat patch is beveled at its edges and adhesive is applied to these beveled edges. The boat patch is then inserted into the cut and the assembly is pressed between heated platens to set the adhesive and anchor the patch in the cut.

The need still remains for an efficient method for patching low grade veneers in order to provide a smooth, flat surface. The ideal patch method would involve a continuous operation with a minimum of supervision in which any surface discontinuities would be located and filled automatically. The provision of such a method and various types of apparatus for performing this method are the main objects of the present invention.

Other objects of the present invention include the provision of a method for continuously patching wood veneer with a bonding composition and completely filling surface discontinuities in the sheet regardless of their location or configuration. Another object of the invention is to provide a method for patching wood veneer with a readily available, inexpensive filler material such as comminuted wood particles and a binder. Another object of the invention is to provide a method for automatically depositing controlled amounts of a filler into surface discontinuities of a wood veneer.

The present invention provides a continuous means for applying a filler material into surface discontinuities of a moving sheet of veneer and is based upon the maintenance of a pressure differential across the veneer sheet to control the amount of filler material retained in the holes or other discontinuities. The most convenient means for accomplishing this purpose is to provide a continuously circulating gaseous stream in a confined path, and dispersing in this stream a particulated mixture of comminuted filler and a resinous binder. The flow characteristics of the main stream are so adjusted to suspend the filler material uniformly in the air stream. The pressure drop across the discontinuity is so adjusted that the stream when passing into a discontinuity is in a condition of laminar flow.

One of the characteristic features of a stream in laminar flow is the fact that the pressure drop between two spaced points in the stream is a linear function of the velocity of the stream, and this characteristic is used to advantage in the practice of our method.

The amount of material deposited, for example, in a knothole under such conditions is the product of the concentration of filler composition per unit volume in the stream and the total volume of the stream passing through the hole. Hence, the material deposited in a given hole can be represented by the equation:

$$M_1 = C_0 Q_1$$

where M_1 is the quantity of material deposited in the

hole, C_0 is the concentration of material per unit volume in the stream, and Q_1 is the total volume of the stream through the hole. For another hole, the same relationship applies so that:

$$M_2=C_0Q_2$$

where M_2 is the amount of material deposited in the second hole, C_0 is the concentration of filler material per unit volume in the stream and Q_2 is the total volume of the material through the second hole. In the present system, the total quantity of filler circulating in the stream is high with respect to the amount deposited from the stream at any given time, and this small amount of depletion may be ignored because it has a negligible effect upon the concentration of material, C_0.

From the above, the ratio between the amounts of material deposited in the two holes may be expressed as follows:

$$M_1/M_2=C_0Q_1/C_0Q_2$$

but since C_0 cancels out of the equation and the discharge velocities are the products of the areas of the holes and the linear velocity of the stream through the holes, the above equation may be written:

$$M_1/M_2=V_1A_1/V_2A_2$$

where V_1 and V_2 are the velocities through the respective holes and A_1 and A_2 are the areas of the holes. However, as previously brought out, the system is operated under a substantially constant pressure differential, in substantially laminar flow, so the velocity V_1 will equal the velocity V_2, and the final equation may be written:

$$M_1/M_2=A_1/A_2$$

Hence, the amount of material deposited in the surface discontinuities in this process is directly proportional to the area involved.

The present invention thereby provides an automatic means for determining the amount of filler introduced into a surface discontinuity. As the filler material builds up in the surface discontinuity, a point of equilibrium will be reached depending upon the velocity of the stream, the size and density of the particles, the pressure differential existing across the sheet, and similar factors. Once this equilibrium is reached, there is no appreciable additional deposition on the filler material already deposited in the space. Hence, by adjustment of the variables mentioned, the proper amount of filler material will be deposited automatically in the surface discontinuity. Since the filler material has a far lower bulk density than the veneer, the filler will be deposited in volumetric excess of the volume of the hole, leaving a mound of filler material completely covering the hole. Any excess filler material which becomes deposited upon the veneer in its passage through the zone of deposition can be conveniently removed, whereupon the filled sheet can be passed into a pressure means which consolidates the material, making the filler essentially flush with the surface of the sheet.

The preferred filler in the process of the present invention consists of comminuted wood particles and a powdered resin. The method described is, however, equally applicable to the use of numerous types of filler particles, such as ground bark, finely divided straw, mica, and the like. As will appear from a subsequent discussion, particles of this type can be combined with a resin having adhesive properties to provide a filler which adheres well to the surface defects in the veneer. As described later, the resinous constituent may be a thermosetting resin, a thermoplastic resin, or mixtures of the two types of resins.

A further description of the present invention will be made in connection with the attached sheets of drawings which illustrate several modified forms of apparatus useful in performing the described methods.

Figure 1 is a view in elevation and partially in cross-section of a continuous and automatic veneer patching mechanism;

Figure 2 is a fragmentary, enlarged, cross-sectional view of a piece of veneer shortly after it has been contacted with the stream of filler;

Figure 3 is a view similar to Figure 2, and illustrates the same piece of veneer shortly after the time illustrated in Figure 2;

Figure 4 is a view similar to Figure 2, and illustrates the piece of veneer at a still later time;

Figure 5 is a view similar to Figure 2, and illustrates the veneer after the excess patching material has been removed from the edges of the defect;

Figure 6 is a schematic view of another form of apparatus; and Figure 7 is a schematic view of a still further modified form of apparatus.

In the assembly shown in Figure 1, reference numeral 10 indicates generally a housing consisting of a suction box 11 and a deposition chamber 12. The suction box 11 has a perforated upper plate 13 which has an end portion 13*a* extending somewhat beyond the end of the deposition chamber 12. An endless belt consisting of a foraminous member in the form of a wire screen 14 of relatively fine mesh for example, one having twenty-four wires per inch, is trained about a pair of rolls 16 and 17 which are journalled for rotation on shafts 18, and 19, respectively.

The suction box 11 is connected by means of a conduit 21 to the inlet end of a blower 22 of relatively high capacity. The flow of air through the conduit 21 is controlled by a blast gate 25. The blower 22 should be sufficiently large so that changes in vacuum in the suction box 11 due to variation in the number of discontinuities in the veneer sheets being treated does not change the vacuum conditions significantly.

The deposition chamber 12 and the suction box 11 are maintained at different predetermined pressures and preferably both are maintained under subatmospheric pressure conditions. For example, the suction box 11 may be maintained at a vacuum of about 9 inches of water while the deposition chamber 12 may be at a negative pressure of ½ to 1 inch of water.

Outside the suction box 11, the wire 14 travels over a perforated pipe 24 which directs a stream of air to the wire mesh to clean out any wood powder which has become deposited in the screen.

Within the deposition chamber 12, means are provided to regulate the flow characteristics of the air stream carrying the comminuted particles and the resinous binder. These means may include a plurality of baffles 26, 27, and 28, each of which is vertically adjustable by means of wing nuts 29, 30, and 31 which secure each of the baffles in a selected vertical position.

The comminuted mixture of wood particles and resin binder is introduced into the system from a hopper 32 provided with a worm feeding mechanism 33. The hopper 32 introduces the particulated mixture into an inlet conduit 34 which delivers the material into the blower 22 to be discharged therefrom into an outlet conduit 36. The particle laden air is then introduced into the top of a cyclone separator 37 and after passing through the latter, enters the deposition chamber 12 through an orifice 38 provided with an adjustable series of baffles 39. The velocity of the air stream can be controlled by means of a blast gate 41 disposed immediately above the hopper 32 in the inlet line 34.

As a veneer panel 43 is introduced into the deposition chamber 12 on the wire 14, it moves into contact with a constantly flowing gaseous stream containing the filler particles and resin in suspension. The path of the stream is essentially confined to flow through the orifice 38, under the baffles 26 and 27, between the baffles 28 and 27, into conduit 34, into blower 22, through conduit 36, and finally through the cyclone separator 37.

Initially, the buildup of filler particles and resin proceeds substantially normal to the surface of the veneer 43. This condition is illustrated in Figure 2 where a

knothole 46 is shown substantially filled with a resin-filler mixture 44. Within a short time, an equilibrium condition is reached in which a mound 44*a* is built up over each of the surface discontinuities 46 present in the veneer 43. This point is illustrated in Figure 3. At this point, the path of least resistance for the air stream is along lines which are more radial than normal, and deposition of the filler then becomes greater along the edges of the surface defect and usually results in a relatively heavy buildup 44*b* (Figure 4) of filler along edges of the mound 44.

As the veneer 43 proceeds through the deposition chamber 12 it passes under the depending baffle 27 and is then subjected to the action of a cleaning air stream, as for example, from a perforated pipe 47. The baffle 28 controls the direction of the air stream from the pipe 47 and together with the baffle 27 provides a channel for the removal of excess filler. The material being continuously removed by the cleaning air stream is then directed into the conduit 34 associated with the blower 22.

In place of the perforated pipe 47 it is possible to employ a soft brush or a series of brushes as the means for brushing off excess material from the veneer. However, the air stream is much more convenient to use than a soft brush and is therefore preferred. The term "brushing" as used in this specification should be applied to various suitable means for removing excess powdered material, whether by mechanical brushing means or by an air brush. After the excess filler material has been removed from the veneer sheet, the filler deposit will have been reduced, as illustrated in Figure 5. The exact size and shape of the remaining material will depend primarily on the size of the filler particles and the pressure differential existing across the deposit 44 at the time the excess was removed.

The veneer 43 is then subjected to a slight pressing action by means of a slack rubber belt 48 supported between a soft rubber-covered press roll 49 and small roll 50. It should be noted that at all times during the removal of surface filler material the veneer 43 is still subjected to suction from the suction box 11 and this condition exists until the veneer sheet has traveled beyond the press roll 49.

The patched sheet is then received on a highly polished transfer plate 51 which is preferably cooled so as to prevent the resinous component of the filler from becoming tacky and sticking to it.

The transfer plate 51 guides the veneer between a pair of vertically adjustable belt supporting rolls 52 and 53. A narrow spring arm 54 serves to prevent vertical movement of the veneer in its passage between the rolls.

The roll 52 and a second roll 56 are both supported on a support 57 which is pivoted to a frame by means of a pivot 58. A flexible metal belt 59 extends between the rolls 52 and 56, the belt 59 being heated by means of radiant heaters 60 supported above the rolls 52 and 56. The lower assembly, consisting of rolls 53 and 61, is mounted on a support 62 in spaced relation with the rolls 52 and 56, the nip pressure between rolls 56 and 61 being adjustable by means of a spring assembly 63 associated with a spacer rod 64 between the supports 62 and 57.

A flexible metal belt 65 extends between the rolls 53 and 61 and is heated by radiant heaters 66 disposed beneath the rolls.

The various rolls are driven by means of belts or gears from shafts 67 and 68 which themselves are geared together. The shaft 67 is associated with a chain driven gear 69 driven from a drive system generally indicated at 71 and powered by a motor 72.

The temperature conditions to which the veneer is subjected in passing through the heated roll assembly will vary with the type of resin employed, the amount of resin, and the subsequent processing to which the veneer is to be put. Where the veneer panel is to be heat bonded to other veneer panels in the manufacture of plywood, then the temperature conditions need only be sufficient to partially melt the resin to cause the filler particles to adhere together as the subsequent plywood making step will effectively cure the resin completely. However, if desired, the complete cure can be carried out in this stage.

The pressure on the veneer sheets applied by the belts 59 and 65, in passing between the rolls 56 and 61, is sufficient to press the filler material flush with the surface of the veneer, thereby forming a relatively high density plug in each of the surface discontinuities.

Numerous different types of thermosetting and thermoplastic resins can be employed for the purposes of the present invention. Phenol-formaldehyde, urea-aldehyde, melamine-aldehyde resins, and natural thermoplastic resins are among those resins which may be employed. For those thermosetting resins which have some thermoplastic properties in their unset condition, the filler mixture may include merely the comminuted particles such as sander dust or sawdust and the thermosetting resin. However, for those resins which do not have sufficient thermoplasticity, it is often desirable to add a thermoplastic resin having adhesive properties to the mix.

If the patched veneer is to be secured to other plies in a cold gluing process, then the resinous binder may be a thermoplastic resin alone. Where a hot pressing operation is to be employed, then the use of some thermosetting resin would be indicated. Where the filler particles are used with either the thermosetting or thermoplastic resin alone, best results are obtained where 5 to 50 parts of the resin are added to every 100 parts of the comminuted material. Where both types of resins are included, from 5 to 50 parts of thermoplastic resin in combination with 2.5 to 10 parts of the thermosetting resin for every 100 parts of filler particles may be employed. As the thermoplastic resin, we prefer to use an inexpensive, natural resin known commercially as "Vinsol" resin. This material is a hard, brittle, dark colored thermoplastic resin derived from pine trees and containing phenol, aldehyde, and ether groups. A typical sample has a specific gravity of 1.2 to 1.3, a melting point of 230 to 240° F., and an acid number of between 90 and 100. Other suitable low melting thermoplastic resins include methacrylate polymers and polyethylene resins.

Various specific examples for filler mixtures are given below:

Example I

1500 parts sander dust
500 parts Vinsol
150 parts Durez 14184 (powdered thermosetting phenolic resin)

Example II

500 parts sander dust
55 parts Bakelite QR 18615 (powdered thermosetting phenolic resin)

Example III

450 parts sander dust
50 parts powdered melamine-formaldehyde condensation product

Example IV

1500 parts sander dust
500 parts Vinsol

Example V

90 parts sawdust
5 parts Vinsol
5 parts Durez 14184

Example VI

90 parts sawdust
7.5 parts Vinsol
2.5 parts Durez 14184

Example VII

80 parts sander dust
20 parts polymerized n-butyl methacrylate (Hypalon P–4)

Example VIII

80 parts sander dust
20 parts polyethylene resin (Alathon GP–1000)

Example IX

80 parts sander dust
20 parts polyethylene resin
10 parts phenolic resin

Various changes can be made in the specific examples mentioned above depending upon the type and density of the filler desired. In general, as a coarser filler is used, the relative amount (percentagewise) of resin can be decreased.

The amount of resin can be changed for various reasons. For example, if the filled veneer is to be used as a facing strip for plywood, it is desirable to use a relatively large amount of resin in the mix to provide more water resistance, more abrasive resistance, or more surface hardness.

Other systems of apparatus for distributing the filler material onto the veneer have been illustrated in Figures 6 and 7 of the drawings. Figure 6 illustrates a system in which a hopper **77** containing the powdered filler material **78** applies a more or less uniform layer **79** of filler material over a traveling veneer sheet **80** supported on a moving endless wire screen **81**. The screen **81** is driven by a pair of rolls **82** and **83**. As the filler material **78** is distributed along the veneer **80**, it will loosely fill surface discontinuities such as knotholes **80***a* in the veneer **80**. The veneer sheet **80** advances over a suction box **84** over which it travels until it is subjected to the action of an air stream from a source of pressured air such as a perforated pipe **86**. The air stream from the pipe **86** blows away the excess material but the previously applied suction from the suction box **84** retains the deposited filler in the surface defects such as knotholes **80***b*. The loosely filled veneer can be passed to heating and pressing apparatus which consolidates the excess filler into a plug flush with the surface of the veneer.

In the system of Figure 7, a veneer sheet **90** is carried along an endless wire screen **91** supported between a pair of rolls **92** and **93**. A suction box **94** provides the suction to hold the sheet **90** against the screen **91**. As the veneer **90** passes over the housing **95**, it is contacted with an air stream containing the resin-filler mixture **96** circulating within the housing **95** by the action of a pump **101**. In this type of system, the cleaning air stream may be eliminated in some cases. As the veneer **90** travels beyond the end of the suction box **94**, it is gently transferred to the surface of a metallic belt **100** trained about a roll **97**.

The veneer **90** travels on the belt **100** into contact with a heated belt **98** trained about a roll **99**. Preferably, both the belts **100** and **98** are heated to effect softening of the resin binder in the filler. The belts **100** and **98** then deliver the veneer **90** to press rolls where the material is heated and consolidated into a self-sustaining mass.

The present system provides a convenient means for patching veneers in an automatic manner. The necessity of providing machines for cutting out surface defects and replacing them with special patches has been eliminated by the system of the present invention.

It will be evident that various modifications can be made to the described processes and apparatus without departing from the scope of the present invention.

We claim:

1. The method of patching an opening extending through a generally plane member, which comprises providing a constantly flowing gaseous stream containing comminuted solid filler particles, supporting said plane member on a foraminous member in a position generally parallel to the direction of flow of the gaseous stream and in surface contact with the constantly flowing gaseous stream, said foraminous member being disposed on the side of said plane member opposite that which is in contact with said gaseous stream, and providing suction on the side of said plane member opposite the gaseous stream, thereby drawing filler particles from the stream only into said opening through said plane member and filling said opening at least to the level of the opposite surfaces of said plane member.

2. The method of patching an opening extending through a generally plane member, which comprises providing a constantly flowing gaseous stream containing comminuted solid filler particles having a lower density than the density of said generally plane member, supporting said plane member on a foraminous member in a position generally parallel to the direction of flow of the gaseous stream and in surface contact with the constantly flowing gaseous stream, said foraminous member being disposed on the side of said plane member opposite that which is in contact with said gaseous stream, and providing suction on the side of said plane member opposite the gaseous stream, thereby drawing filler particles from the stream only into said opening through said plane member and filling said opening, with said suction being correlated with the density of said filler particles and with the characteristics of said gaseous stream so that the volume of filler particles drawn into said opening exceeds the volume of said opening and forms a mound of filler material completely covering said opening.

3. The method of patching a plurality of spaced-apart openings extending through a generally plane member, which comprises providing a constantly flowing gaseous stream containing comminuted solid filler particles having a lower density than the density of said generally plane member, supporting said plane member on a foraminous member in a position underlying said gaseous stream and generally parallel to the direction of flow thereof, thereby placing said plane member in surface contact with the gaseous stream, said foraminous member being disposed beneath said plane member, and providing suction on the bottom side of said plane member, thereby drawing filler particles from the stream into each of the openings in said plane member that are disposed between the flowing gaseous stream and the suction and filling said openings, said suction being correlated with the density of said filler particles and with the characteristics of said gaseous stream so that the volume of the filler particles drawn into each of said openings is determined by the area of each opening and so that each of said volumes of filler particles exceed the volume of the opening filled thereby and forms a mound of filler material completely covering the opening, said volumes of filler particles being such that upon compression the openings are filled to the level of the opposite surfaces of said plane member and the density of the material in each opening is essentially the same as the density of said plane member.

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