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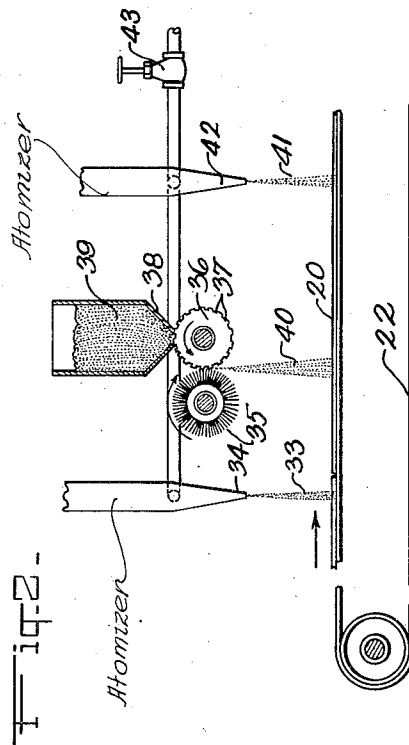
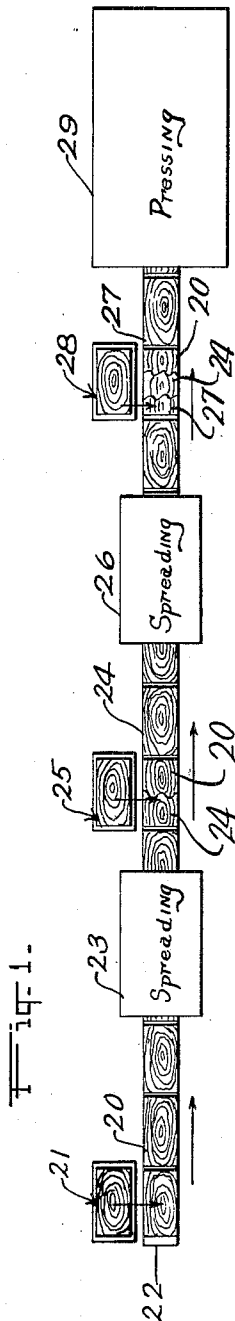
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1,870,041

METHOD AND APPARATUS FOR THE FORMATION OF PLYWOOD AND THE LIKE

Filed May 21, 1931

5 Sheets-Sheet 1



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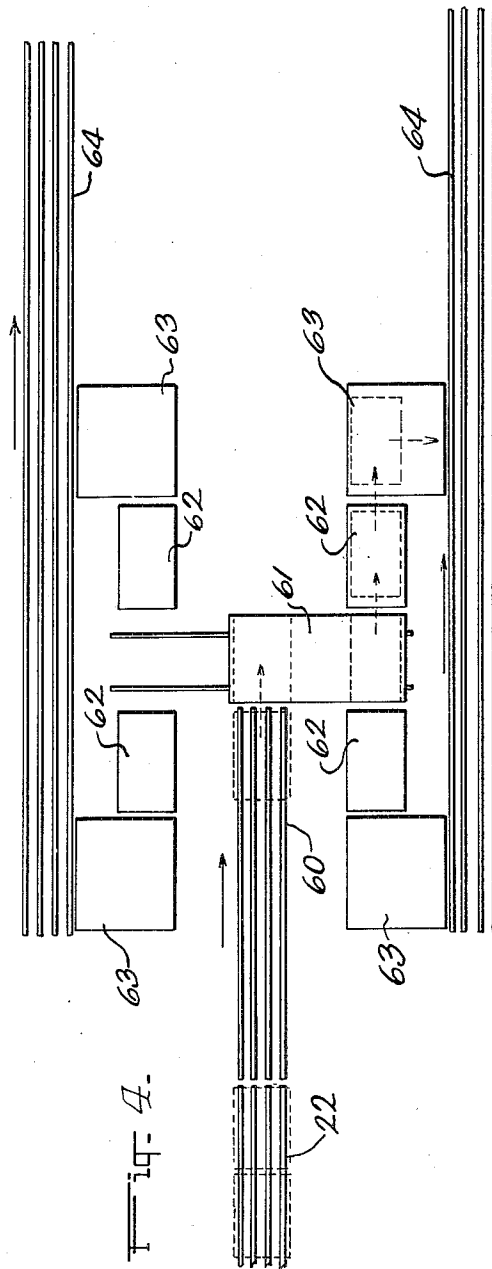
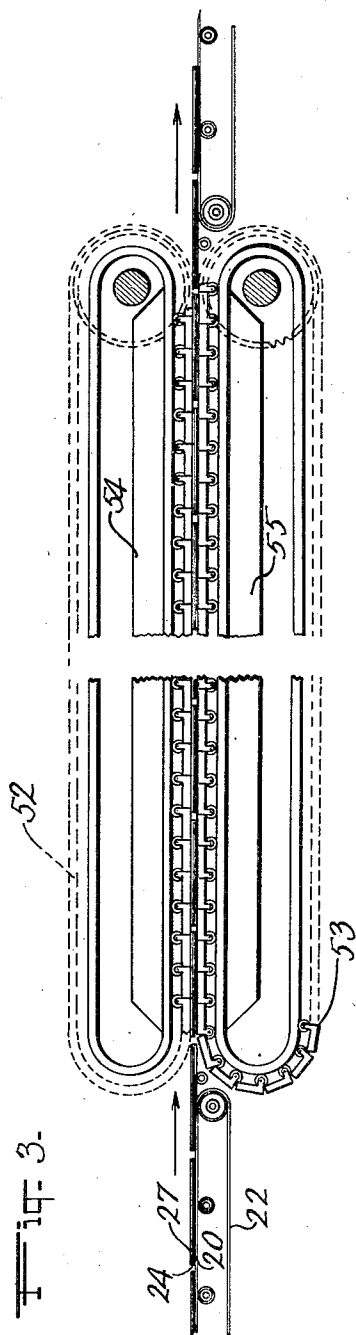
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METHOD AND APPARATUS FOR THE FORMATION OF PLYWOOD AND THE LIKE

Filed May 21, 1931

5 Sheets-Sheet 2



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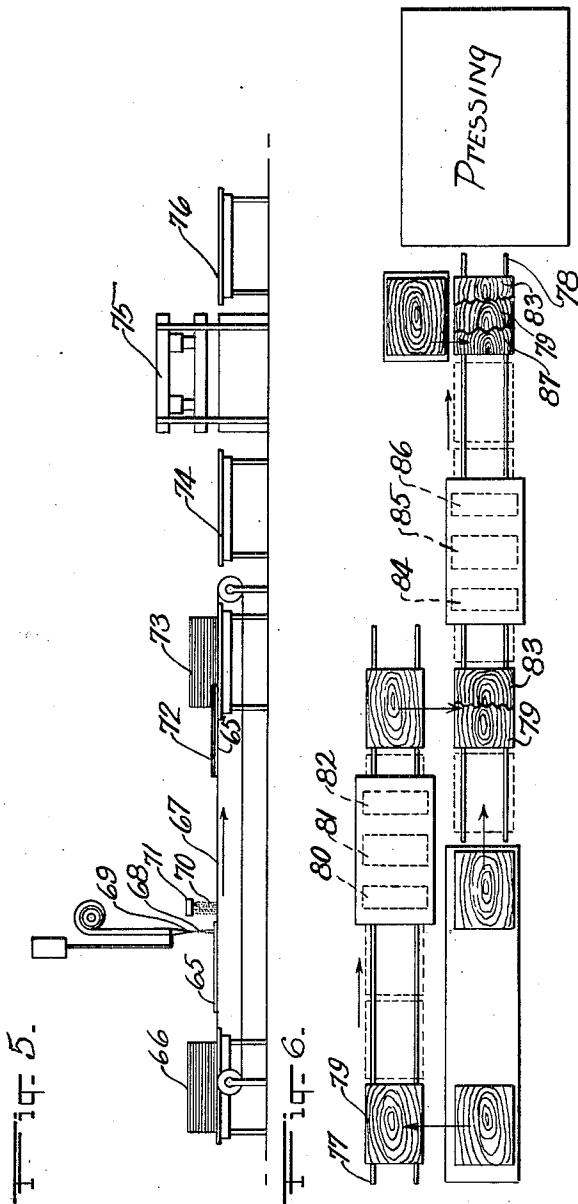
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1,870,041

METHOD AND APPARATUS FOR THE FORMATION OF PLYWOOD AND THE LIKE

Filed May 21, 1931

5 Sheets-Sheet 3



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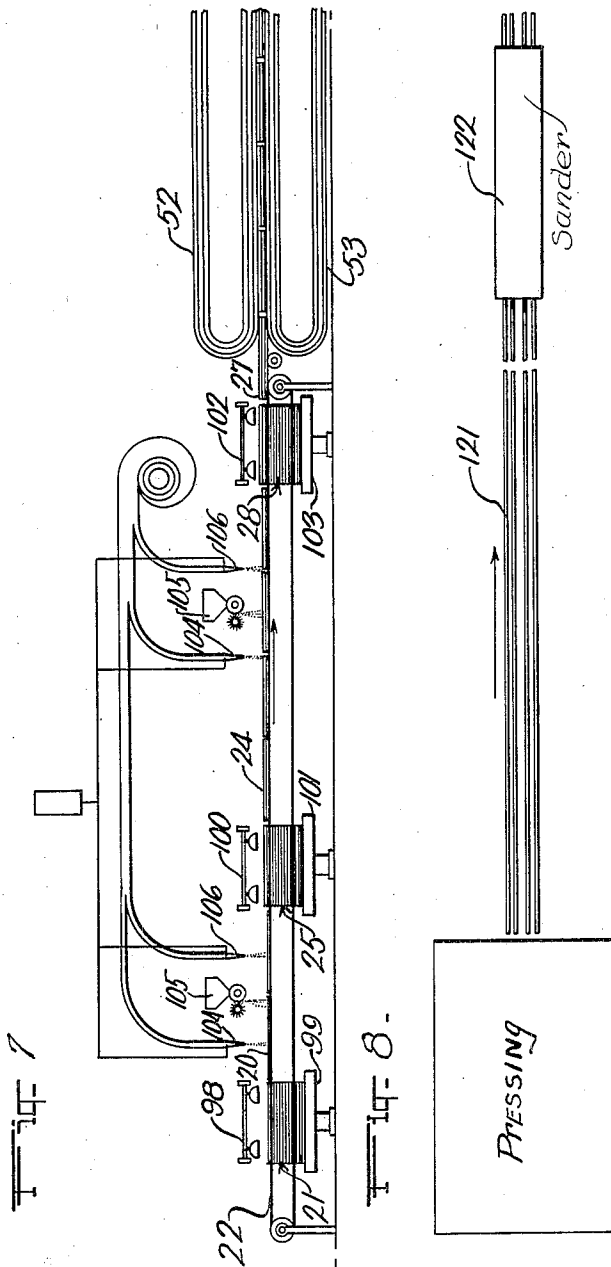
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METHOD AND APPARATUS FOR THE FORMATION OF PLYWOOD AND THE LIKE

Filed May 21, 1931

5 Sheets-Sheet 4



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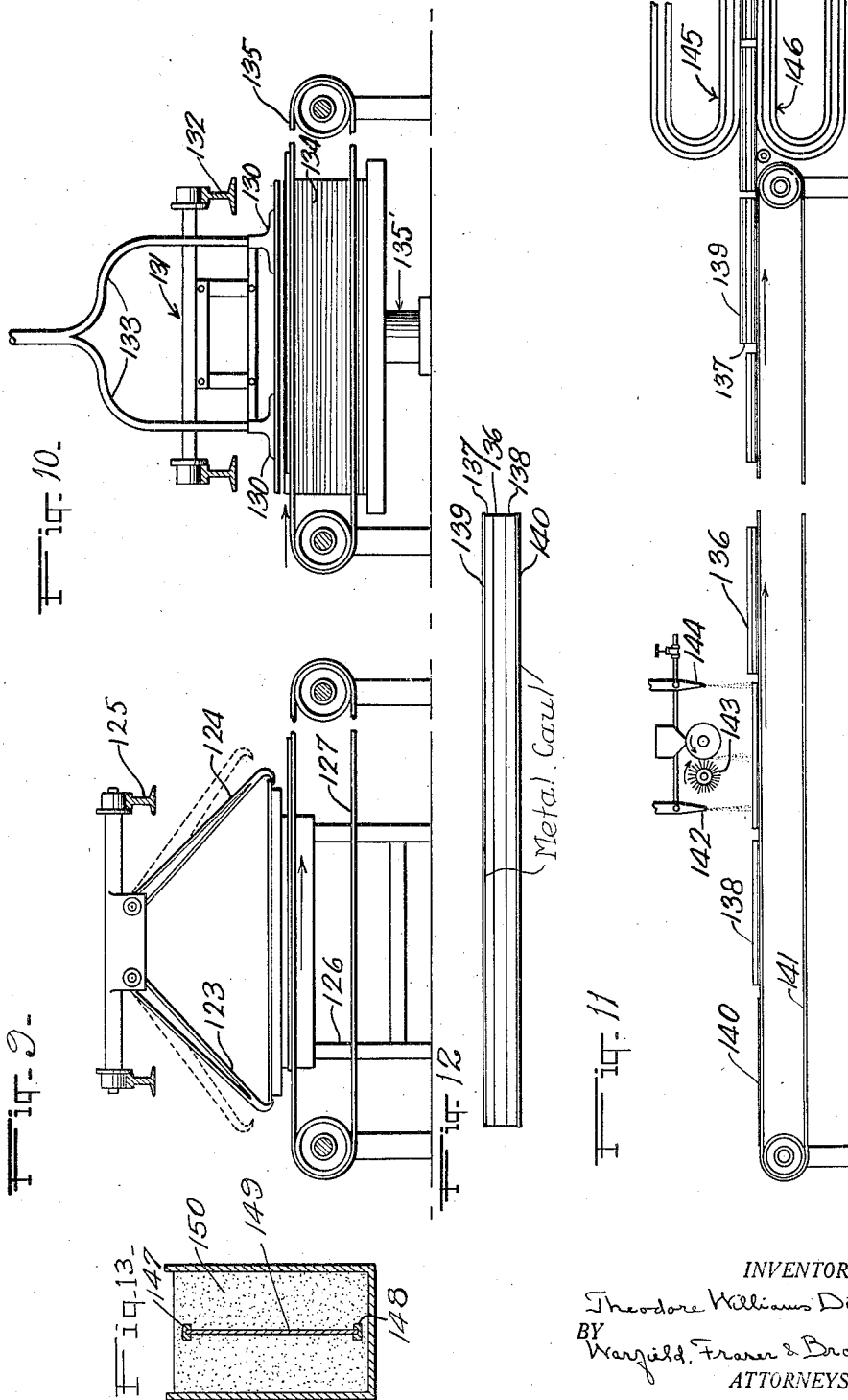
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METHOD AND APPARATUS FOR THE FORMATION OF PLYWOOD AND THE LIKE

Filed May 21, 1931

5 Sheets-Sheet 5



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METHOD AND APPARATUS FOR THE FORMATION OF PLYWOOD AND THE LIKE

Application filed May 21, 1931. Serial No. 538,983.

This invention relates to gluing methods and apparatus, and more particularly to methods and apparatus for the formation of plywood.

The present application is, in part, a continuation in part of my co-pending applications Serial No. 335,998, filed January 29, 1929, and renewed March 10, 1931; Serial No. 455,978, filed May 26, 1930, issued March 29, 1932, as Patent No. 1,851,951; Serial No. 456,813, filed May 28, 1930, issued March 29, 1932, as Patent No. 1,851,952; and Serial No. 456,814, filed May 28, 1930, issued March 29, 1932, as Patent No. 1,851,953.

In general, it is an object of the invention to provide improved methods whereby members may be readily, efficiently and effectively united in a desirable manner. Another object is to provide methods whereby there may be readily produced high grade structures of uniform quality.

A further object is to provide improved methods whereby there may be effectively and efficiently produced plywood which possess strength, endurance and appearance and other qualities of a nature which are particularly desirable for the uses to which the plywood produced is to be put.

Another object is the provision of a method of forming plywood, wherein each finished panel of a series will have qualities as closely as possible like those of each other panel of said series.

More specifically, it is an object of the invention to continuously produce a series of panels of substantially uniform qualities and characteristics.

Another object is to combine a plurality of plies into a panel with particular efficiency and effectiveness.

Another object is to provide apparatus adapted for use in certain procedures involved in carrying out methods such as contemplated by the invention.

A further object is to provide certain forms of apparatus adapted for the efficient and effective production of plywood.

Other objects of the invention will in part be obvious and will in part appear hereinafter.

The invention accordingly comprises the several steps and the relation and order of one or more of such steps with respect to each of the others, and the apparatus embodying features of construction, combinations of elements and arrangement of parts which are adapted to effect such steps, all as exemplified in the following detailed disclosure, and the scope of the application of which will be indicated in the claims.

For a fuller understanding of the nature and objects of the invention reference should be had to the following detailed description taken in connection with the accompanying drawings, in which:

Fig. 1 is a somewhat diagrammatic plan view of apparatus exemplifying one form of method embodying the invention;

Fig. 2 is a partly-sectional side view on an enlarged scale exemplifying one type of means for applying gluing materials to materials to be glued in carrying out the invention;

Fig. 3 is a side view exemplifying one type of bonding mechanism adapted for use in carrying out the invention;

Fig. 4 is a somewhat diagrammatic plan view of another type of bonding mechanism adapted for use in carrying out the invention;

Fig. 5 is a side view of another form of apparatus adapted for use in carrying out the invention;

Fig. 6 is a plan view of still another form;

Fig. 7 is a side view of a further modified form of apparatus;

Fig. 8 is a somewhat diagrammatic plan view of apparatus exemplifying an additional procedure adapted to be performed in accordance with the invention;

Fig. 9 is a side view exemplifying one type of apparatus for disposing plies on a conveyor in accordance with the invention;

Fig. 10 is a similar view of another form;

Fig. 11 is a side view of apparatus exemplifying another form of the invention;

Fig. 12 is an enlarged side view of an arrangement ready for pressing, as indicated in Fig. 11; and

Fig. 13 is a somewhat diagrammatic show-

ing of another type of means for applying powdered adhesive material to members to be glued.

While the invention in many of its aspects is adapted for use in a wide variety of gluing methods, it is more particularly concerned with the formation of plywood, and, in many of its aspects deals with the solution of problems met with primarily in the gluing of veneers, or other materials of a relatively porous or fibrous nature.

It is to be understood in this connection that the term "plywood" as used herein, is intended to include not only laminated structures, the plies of which are composed of natural wood, but also structures, of which part, and in some cases all, of the plies are composed of artificial sheet material used as substitutes for natural wood plies, and that it does not exclude structures wherein there are also included one or more plies of other material such for instance as steel, aluminum, paper, etc.

A broad variety of gluing methods adapted for use in the formation of plywood have been proposed. While many of these methods have a relatively wide use there is still a large and unsatisfied demand for plywood panels having a relatively large number of desirable qualities. Among such qualities are uniformity of strength, durability and appearance, both among the panels of a group and throughout an individual panel; freedom from blisters, cracks or strained portions; and, in many cases, water-resistance; and resistance to temperature conditions. There is also a wide field for use of plywood in place of other, and often inferior, materials, which field can be occupied by plywood produced in quantities at a relatively small cost and with substantial freedom from objectionable defects.

It is accordingly desirable to produce plywood having one or more, and, preferably all, of the foregoing desirable qualities, and it is particularly desirable that such plywood be produced in quantity with a maximum of uniformity and efficiency and a minimum of labor or expense.

With the foregoing and other ends in view the present invention contemplates the provision of improved methods adapted for the expeditious and effective production of plywood, and particularly for so producing plywood in a manner well adapted for the manufacture of quality products.

The gluing methods in common use give rise to numerous difficulties in effectiveness of operation and in quality of product, due in part to the use of liquid glues and in part to the haphazard methods employed, and with the solution of these and other difficulties in view the present invention contemplates the application of the adhesive material in discrete-particle form, and the provision of im-

proved methods and apparatus involving such applications that outstanding results may be obtained.

In connection with the exemplification of such methods, reference will be made to various forms of apparatus which may be used in the performance thereof. A number of such forms of apparatus, which are illustrated and described herein to the end that a more ready understanding of the present invention may be had, form the subject matter of various applications of myself and others which have been previously filed, are filed herewith, or will be filed in the future. The present invention, however, contemplates also the provision of certain forms of apparatus particularly adapted for use in the performance of such methods. To a like end, reference will also be made to various methods which form the subject matter of applications of myself and others, and not claimed herein.

It is particularly to be understood that while various preferred types of methods and apparatus are exemplified herein, the invention nevertheless embraces a wide variety of procedures and apparatus and that the various steps and mechanisms exemplified may be widely modified. Moreover, steps or mechanism exemplified in connection with the description of preferred forms of procedure or apparatus may in many instances be omitted without departing from the invention in its broader aspects.

In its preferred form, the invention contemplates continuously and concurrently applying gluing material, (i. e. any material utilized in the joining of the plies) to surfaces of plies of one or more series, and building up assemblies including the coated surfaces in a manner such that a series of assemblies will be completed one after another by steps which are substantially uniform for each assembly, and, preferably, at intervals spaced but a short time one from the other; delivering each assembly to bonding mechanism in a uniform, and preferably short, time interval after it is completed; and subjecting each assembly to bonding conditions for a uniform, and preferably for a relatively short, time interval.

In general, each of the steps or procedures above noted may be accomplished in a variety of ways, several of which will be mentioned immediately below, and a few of which will be particularly exemplified hereinafter, it being borne in mind that certain of the procedures outlined and exemplified are particularly adapted for use under certain conditions and in certain particular types of operations, while others thereof are particularly adapted for use under other conditions and in other particular types of operations.

The coating of plies may be readily accomplished, for example, by moving a series of

plies one after another along a path such that the surface of each ply will receive during its movement a coating of adhesive materials from apparatus adapted continuously to supply adhesive material in uniform quantities to the moving plies, associating the surface of another ply with each coated surface as the movement continues, and similarly performing such supplemental coating and assembly steps as may be desirable in a particular instance. Again, two surfaces of each ply of one series may be coated in a suitable manner for the method contemplated, and a ply of each of two other series associated with the coated surface in any suitable manner or any suitable time for each ply of the first series. Other suitable variations in the surfaces coated and the manner of associating plies of different series may be made. It is of importance, however, in obtaining panels of particularly uniform qualities that the coating and assembling steps with respect to the plies of the various series should be similar throughout.

The gluing material applied ordinarily consists of or includes material which in itself possesses adhesive qualities or which, under the conditions obtaining at the glue line, is converted into a substance possessing such qualities. All such materials will be referred to herein as "adhesive materials." Such materials may be such as require a given amount of plasticizing agent for effecting the desired union at the glue line, or may be materials which under suitable conditions, such as the presence of heat, are suitably plasticized. In the case of materials requiring the presence of a plasticizing medium, an additional gluing material in the nature of a plasticizing medium, for example, water, may be supplied thereto. In instances where one or more of the plies themselves contain sufficient excess moisture so that they will yield up such moisture to the adhesive material, no additional supply of plasticizing medium is ordinarily necessary. However, in the gluing of relatively dry materials, which in many cases is a preferable procedure, it is in some cases desirable to apply a liquid, for example, water, in suitable proportions either before, with, or after the application of an adhesive material, or at two or more such times.

Other suitable addition agents may be applied with one or another of the materials applied, or separately therefrom, as desired.

The application of adhesive or other materials to the surfaces of the plies, i. e., the "spreading" or "coating" of the plies, may be accomplished in a variety of ways. Mention may be made of various examples of spreading procedures. The plies may be successively passed through a zone in which an adhesive or other material is disseminated in such manner that it will be received by a sur-

face of each ply as the ply passes through said zone; for example, as described and claimed in my co-pending application, Serial #518,944, filed February 28, 1931. The plies may be otherwise coated in a suitable manner without contact of the applying means with the coated surface. The plies may be successively dipped in, passed thru, or otherwise brought into contact with the adhesive material. One surface only of each ply may be coated in a single operation or both surfaces of a ply may be so coated. It will be appreciated that various types of such procedures are particularly advantageous in various types of work, the dissemination procedure being of especial advantage in a large number of instances.

Preferably the assembly step or steps are conducted while the coating of plies continues, and this is accomplished with particular readiness when the assembly steps are performed without halting the movement of the plies. Such assembly steps may be performed between the coating of various of the surfaces contained in the assembly being formed or after all the coating steps, as best suits the type of operation and the characteristics desirable in the particular operation involved.

The bonding of the assemblies and the delivery of the same to bonding mechanism is preferably accomplished with the greatest possible uniformity consistent with the type of operation. In its broader aspects the invention contemplates performing a bonding operation either with or without the use of heat. For example, there may be utilized either a hot or a cold press or a combination of the two, and in certain instances there may be utilized heat which has been stored in one or more of the plies. In the latter connection reference is made to the co-pending application of Irving F. Laucks, Charles N. Cone, and myself, Serial No. 447,428, filed April 25, 1930, issued March 29, 1932, as Patent No. 1,851,709. Processes involving the utilization of heat are especially desirable for use in many cases because of the manner in which bonding is often expedited thereby, and because of its action in securing effective bonding in many desirable types of procedures.

Preferably each assembly is pressed individually, such action being obtained either in a continuous press wherein the assemblies are progressed between the pressure plates during the pressing operation, or by the use of a plurality of independently-operable pressure mechanisms to which the assemblies are successively delivered. When a continuous press is used the same may be disposed in the path of movement of the plies so that each assembly as it is formed is moved directly between the plates of the pressing mechanism and progressed therebetween.

When independently-operated pressure mechanisms are used the delivery thereto is preferably so timed that the time of delivery of each assembly to a pressing mechanism is the same as the time of delivery of every other assembly. However, in some cases a slight sacrifice in uniformity may be made and a multiple opening press utilized provided suitable care is exercised in promptly loading the press. Such a procedure finds its most likely applications in cases where the adhesive materials used are not subject to rapid change and where the materials glued do not tend to change the conditions at the glue line by the absorption of water from or addition of water to the adhesive material or otherwise.

Whatever type of bonding mechanism is used, the delivery of the assemblies thereto is preferably accomplished in a relatively short time. In instances where a continuous press is employed, this time may be reduced almost to a vanishing point.

In many of its broader aspects the invention contemplates carrying out the procedures in question in either short or long time intervals, as may be advisable in the particular operation being carried out. In a number of instances, however, the efficiency and effectiveness of methods such as contemplated by the invention may be enhanced by so conducting certain of the steps that the performance thereof does not occupy more than a given period of time. In this manner other various steps may be desirably correlated, and various difficulties such as undesirable or irregular changes in the character of the glue may be avoided. For example, it is preferable in many cases that the time interval between the initial coating of a ply and the completion of an assembly including said ply should not exceed three minutes. It is also preferable that the interval between the completion of an assembly and the initiation of the bonding operation should not exceed 2 minutes. It is furthermore preferable that the adhesive material used and the other conditions under which the operation is conducted be so arranged that the bonding operation itself will not exceed the equivalent of 1 minute based on the use of face and back plies $\frac{1}{8}$ " thick.

In bonding operations utilizing heat as well as pressure, it is desirable to avoid any changes in the character of the glue prior to the time when the pressure conditions are proper for bond formation. In particular, when heat coagulable glues are used the coagulation of such glues before the surfaces to be bonded are under full pressure results in the formation of unsatisfactory bonds. Again, in the use of glues embodying a small amount of moisture premature and uneven drying is especially undesirable. Various

other premature heat effects also have objectionable results. With a view to avoiding these and other difficulties pressure may, in certain instances, be applied at a time not substantially later than the time when heat reaches the glue line, but without substantial loss of time in the heating of the assembly after the pressure has been fully applied.

In instances where the adhesive material is maintained in or converted into a more or less fluid condition by the presence of a plasticizing liquid, such as water, as distinguished from instances where only heat or other agency is utilized for this purpose, it is preferable that the water or other plasticizing liquid be present in a definitely controlled amount, although, as above set forth, the methods contemplated by the invention may in many instances be performed when there is an excess of moisture present at the glue line.

As above set forth, when moisture is utilized it may be provided in the plies themselves or from an outside source. In either case the amount of moisture present may be suitably limited. When the plies contain more moisture than is desired, the presence of moisture may be limited by partly drying the same. In instances involving the use of adhesives utilizing water in the uniting of dry material or materials, such as commercially dry veneers, for instance veneers which have recently been dried by a veneer drier or redried in a veneer redryer, which will not give up any substantial amount of moisture to the adhesive material, the moisture supplied may be readily controlled. In instances wherein the moisture is applied from an outside source to materials of a relatively porous nature, the possibility of absorption losses must be taken into account. Evaporation losses, even in relatively rapid processes, may also occur to some slight extent. It has been found that the proportion of water to be applied to commercially dry veneer for the plasticization of water plasticizable adhesive material on each thousand square feet of single glue line area should preferably range between 5 lbs. and 30 lbs. and that the best results are usually obtained when it does not exceed 25 lbs. and often when it does not exceed 20 lbs. If a plasticizing agent other than water is to be utilized, such figures as are given should be modified in accordance with the known plasticizing power of the agent utilized.

By following out a procedure such as outlined immediately above, a final product having a desired final or "shipping" moisture content can be readily obtained in a simple and expeditious manner.

There are outlined below examples of pro-

cedures carried out in accordance with the above:

Example 1

5	3 plies of 1/24" commercially dry veneer of light weight wood producing a panel weighing 200 lbs. per 1,000 sq. ft. bone dry	
	Moisture content of veneer 2 1/2 %	5 lbs. of water content per thousand
10	Blood albumen with 10% lime spread at 15 lbs. per 1,000 sq. ft. of three-ply panel (two glue lines)	
	Plasticizing water 7 1/2 lbs. per 1,000 sq. ft. of single glue line x 2	15 lbs. of water content
	Moisture content of product 10%	
15	Total	20 lbs.

Example 2

20	3 plies of 1/4" commercially dry veneer of heavy wood producing a panel weighing 1200 lbs. per 1000 sq. ft. bone dry	
	Moisture content of veneer 6 %	72 lbs. of water content per thousand
	Soya bean flour spread at 32 lbs. per 1000 sq. ft. of three-ply panel (two glue lines)	
	Plasticizing liquid containing 24 lbs. of water per 1000 sq. ft. of single glue line x 2	48 lbs.
25	Moisture content of product 10%	
Total		120 lbs.

It is to be noted that in both these examples representing a wide range of conditions the moisture supplied is below 50 lbs. per thousand square feet of three-ply product and below 25 lbs. per thousand square feet of single glue line area; and that in neither case can the finished panel have a moisture content greater than 10% when it comes from the press. This figure is well within the range of desirable shipping moisture contents.

It is also to be noted that in a number of instances wherein moisture is supplied, it is desirable that the amount of moisture supplied be limited to that required for effecting the desired union at the glue line.

It is to be borne in mind that while many of the forms of procedure hereinafter exemplified are conducted most effectively and satisfactorily under conditions which do not involve the use of plasticizing liquid in amounts materially greater than set forth in the above discussion, the invention in many of its aspects is not limited to such uses.

While many of the forms of methods suggested or exemplified herein have a number of advantageous features, whether or not the pressing is carried on in the presence of heat, in most cases the use of heat is preferable because of its action in effecting or accelerating the setting of a large number of adhesive materials. Both the intensity and the duration of the heat application may be varied to a considerable extent in accordance with the conditions existing within the assembly during the formation of the bond. A few adhesives, such as the albumens, may be set at temperatures somewhat below 212°, but the action is slow and it is often desirable to heat the

pressure plates to temperatures between 212° F. and 300° F. It is to be borne in mind in this connection that the heat should preferably be so controlled as to prevent the development of bursting pressures within the assembly, while at the same time utilizing sufficient heat to set the adhesive. The degree of heat must be correlated somewhat with the time of pressing, since it has been found that there is often an interval between the maximum time necessary for setting and the minimum time necessary to avoid blistering at a given heat. For example, in bonding an assembly of three 1/8" plies of birch glued with blood albumen in the presence of 10% lime between pressure plates heated to 240° F., neither satisfactory bonding nor noticeable blistering occurred in fifteen seconds, whereas in ninety seconds there was a blister force sufficient to cause rupture, although there was a strong bond. At thirty seconds there was a weak bond and no substantial blistering. However, pressure for between forty-five and seventy-five seconds resulted in the formation of a strong bond, without substantial tendency to blister.

In its preferred form, moreover, the invention contemplates conducting the bonding operation under conditions wherein the quantity of vaporizable material, for example, moisture, in the pressed panel is not reduced a substantial amount below the quantity of vaporizable material in the original plies.

After the binding is completed, the panel may, if desired, be subjected to a finishing operation. It is often desirable that such a step be initiated within relatively short time after the completion of the bonding operation, and in such cases a time not greater than five minutes is preferred. This time allows ample opportunity for the panel to cool, if it has been bonded under heat, while nevertheless excessive delay is avoided.

One method of embodying the invention and adapted for the formation of a three-ply panel is particularly exemplified in Figure 1. A series of plies or "squares" 20 are taken one at a time from a stack 21 and laid upon the active run of a conveyor 22 by which they are moved successively forward. Gluing material is thereupon applied to the upper surface of each of the moving plies as indicated at 23. Any of a number of suitable forms of methods and mechanisms may be employed to perform this glue applying or "spreading" step, besides those particularly exemplified hereinafter (as for example in Fig. 2).

After the spreading of each ply is completed one of a series of plies 24 is taken from a stack 25 and laid on the coated ply 20, after which gluing material is applied, as indicated at 26, to the upper surface of each ply 24 as the movement continues. One of a series of plies 27 is thereupon taken from a stack 28

and laid upon the partial assembly comprising the plies 20 and 24. After each assembly is completed the same is delivered to suitable bonding mechanism and subjected to bonding conditions, as for example by a pressing step as indicated at 29.

One method and means for performing the spreading is exemplified in Figure 2. In this connection, reference is made to my copending applications Serial No. 518,944 filed February 28, 1931, and Serial No. 596,070, filed March 1, 1932, and the copending application of Walter D. Lawshe, myself, and Charles N. Cone, Serial No. 518,945, filed February 28, 1931, as well as other inventive concepts. In this arrangement each ply or partial assembly, for example a ply 20, as it moves on the conveyor 22 passes first through a zone in which an aqueous mist 33 is ejected by an atomizer 34, then through a zone in which a cloud of powdered adhesive material 40 is disseminated by a rotary brush 35, to which the adhesive material is delivered by a roll 36. The periphery of the roll 36 is provided with indentations in the forms of grooves 37, and extends into the bottom of a hopper 38 containing a supply of powdered adhesive material 39. Thereafter the ply passes through a zone in which an aqueous mist 41 is disseminated by atomizer 42. By the operation of a valve 43, or in any other suitable manner, the supply of moisture may be so controlled as to limit the moisture at the glue line to substantially that required for the plasticization of the adhesive material in any particular case. This form of spreading mechanism is accordingly well adapted for use in the production of high quality panels in a particularly short time.

One form of pressing mechanism which may be utilized in accordance with the invention is exemplified in Figure 3. This comprises a pair of endless-belt or caterpillar members 52 and 53, the active runs of which are adapted to be pressed toward one another by suitable means, such as the diagrammatically illustrated compression members 54 and 55. Assemblies including the plies 20, 24 and 27 may substantially immediately after their completion be run off the end of the conveyor 22 and between the caterpillar elements 52 and 53 and subjected to pressure, this pressure being continued as the assemblies are progressed along between the pressure elements. Suitable means for applying heat may be provided in those numerous instances where it is desired to utilize heat as well as pressure to effectuate the bonding.

In instances where it is undesirable or unnecessary to use moving pressure elements any of a variety of other arrangements may be utilized. For example, means for effecting a timed loading of single opening presses may be used, as set forth in the copending application of Ericsson H. Merritt, Serial No.

576,766, filed November 23, 1931. One type of such arrangement, certain details of which form subject matter of the copending application of Louis G. Merritt and Ericsson H. Merritt, Serial No. 599,942 filed March 19, 1932, is particularly exemplified in the form of apparatus embodied in Figure 4. In this arrangement each assembly which is completed on conveyor means such as the conveyor 22, moves onto a conveyor 60 which is operated at a considerably higher speed than the conveyor 22 so as to space the assemblies one from another, as contemplated by the present invention. As the assembly reaches the end of the active run of the conveyor 60 it passes onto one end or the other of a shuttle conveyor 61. This shuttle conveyor is arranged to move back and forth at timed intervals such that as an assembly is delivered to one end thereof a previously received assembly may be removed from the other end and disposed in one of a plurality of suitable presses 62, and pressure applied. Preferably each movement from the shuttle conveyor 61 to the press 62 is performed immediately after the shuttle conveyor places the assembly, and occupies a time interval of constant length. It will accordingly be seen that the time between the completion of each assembly and the delivery of the same to one or another of the presses is the same as the time of delivery of each other assembly. The pressure time of each assembly is likewise preferably kept constant. After pressing, each panel may be placed on a transfer support 63 and thence moved onto one or the other of a pair of offbearing conveyors 64, by which it is carried away to a finishing mechanism or a storage room. When the conveyors 64 are utilized to carry panels from hot presses to finishing mechanisms the active runs thereof are preferably sufficiently extended so that the panels will have cooled to a desired extent by the time they reach the finishing mechanism.

It is to be noted that in the utilization of bonding mechanism such as exemplified in both Figs. 3 and 4, in cases where heated press elements are employed, the two sides of each of the assemblies treated are subjected to uniform heat and pressure conditions.

An especially simple form of method and apparatus embodying certain features of the invention is exemplified in Fig. 5. Plies 65 are taken from a stack 66 and laid at spaced intervals on the upper run of a conveyor 67. Each ply 65 is moved by the conveyor through a zone in which aqueous particles 68 are disseminated by suitable means such as an atomizer 69 and then through a zone in which powdered adhesive material 70 is disseminated by suitable means such as a vibrating screen 71. One of a series of plies 72 taken from a stack 73 is thereupon laid upon the ply 65 and the assembly thus formed

is run onto a support 74 and, preferably immediately, placed in a press 75. Under conditions that permit quick pressing,—for example, when the press is heated and a quick setting heat coagulable adhesive material, such as blood albumin, is utilized in conjunction with a relatively small amount of moisture,—and when the plies 65 have been properly spaced on the conveyor 67, a pressing of one panel will be completed as another panel reaches the support 74 ready for pressing. As the bonding of each panel is completed, it is moved from the press 75 to a suitable support 76.

While the path traversed by the plies during the performance of the spreading and assembly operations is preferably a straight line, such a path, when so traversed, may be other than a straight line in many instances.

One such arrangement is exemplified in Fig. 6, wherein there is illustrated an apparatus comprising a pair of parallel conveyors 77 and 78. The plies 79 of a series are placed successively on a conveyor 77 and passed through a zone 80 in which a disseminated liquid is falling, through a zone 81 in which a disseminated powder is falling, and through a zone 82 in which a disseminated liquid is falling. Each coated ply is thereupon lifted, turned over and placed with its coated surface downward upon the upper surface of one of a series of plies 83, which are placed one at a time on the conveyor 78. Each partial assembly thus formed is passed through zones 84, 85 and 86 similar to the zones 80, 81 and 82, and an additional ply 87 disposed against the coated surface of this partial assembly. Each assembly thus formed is thereupon delivered to pressing mechanism,—for example, in one or another of the manners indicated above,—and pressed therein.

In Fig. 7 there is shown in somewhat greater detail one form of apparatus such as may be utilized in performing an operation such as indicated in Fig. 1. Automatic means 98 are provided for moving each ply 20 from a stack 21. Elevator means indicated diagrammatically at 99, are provided for lifting the stack 21 as plies 20 are removed therefrom. Forms of apparatus of this nature form the subject matter of an application by Ericsson H. Merritt, Serial No. 594,011 filed February 19, 1932. Such apparatus, as well as other types of apparatus to this end will be more particularly exemplified hereinafter. Similar apparatus is exemplified at 100 and 101 in connection with the stack 25; and at 102 and 103 in connection with the stack 28. Disseminating means comprising elements 104, 105 and 106 are exemplified as disposed between the stacks 21 and 25 and between the stacks 25 and 28. After each completed assembly is formed it is passed between the

caterpillar elements 52 and 53 of a continuous press.

The pressed panels, whether pressed in a continuous or an intermittent pressing mechanism, and whether pressed individually or together, may be withdrawn from a press and permitted to cool and thereupon subjected to such finishing operations as may be desirable. When the water or other plasticizing agent, with the exception of such small part thereof as may have evaporated during the pressing, has been utilized in the bond formation substantially in its entirety, there is no necessity for subjecting the panels to further drying operations. They can accordingly be conducted in a suitable manner as, for example, on a conveyor 121, Fig. 8, to a sanding mechanism 122 or other smoothing apparatus, and thence immediately to a trimmer or other device for properly completing the finishing. The run of the conveyor 121 between the press and the sander should, preferably, be of sufficient length to allow for the proper cooling of the panels during their movement.

In Figure 9 there is exemplified one type of automatic means adapted for use in moving a ply from a position at one side of a conveyor and setting it on a conveyor or on a coated surface of another ply in movement on the conveyor. This means consists of a pair of gripper members 123 and 124 carried on laterally extending track means 125. There may be provided suitable means for causing a timed closing and opening action of the grippers when they are above a support, such as a table 126, and above a conveyor, such as 127, respectively; and also for causing the reciprocation of the gripper unit on the track means.

There may also be utilized an arrangement such as that forming the subject matter of the above mentioned application of Ericsson H. Merritt, Serial No. 594,011, filed February 19, 1932, one form of which is exemplified in Figure 10. This arrangement comprises a plurality of vacuum cup members 130 forming part of a unit 131 which reciprocates on track means 132. The vacuum cup members may be connected with a suitable evacuating means, not shown, by means of conduits 133. Mechanism of any well known or suitable type may be provided for timing the evacuation of the cup members and the restoration of normal pressure therein, and for the timing of the reciprocation of the unit. As will be seen the unit acts to lift plies one by one from a stack 134 and to deposit or set the same on a conveyor 135 or on a ply carried thereon. Elevator means, as indicated at 135', is preferably provided to progressively lift the stack as plies are removed therefrom.

As above set forth, it is of importance in many instances that the pressure reach the glue line before heat has affected the adhesive.

material thereat. At the same time it is desirable that the effect of heat on the adhesive material be not unduly delayed so as to unnecessarily retard the process with a resultant necessity for greater total press area. It has been found that both these desired results can be secured by the provision of caul members of a material having a high heat conductivity, such as metal, at each side of the assembly and in some cases the plurality of assemblies to be pressed. Such metallic caul members may be made of sheet metal of any suitable thickness. In certain instances perforated sheet metal or wire mesh cauls may be advantageously utilized. The use of the latter permits the venting of the assembly,—for example, as set forth in my copending application Serial No. 454,832, filed May 22, 1930, as, for example, in instances where a relatively large amount of water or other liquid is employed.

In Fig. 12 there is exemplified an assembly comprising a core 136, face and back plies 137 and 138, and sheet metal cauls 139 and 140. When such an arrangement is placed in a hot press, the penetration of heat to the glue lines is retarded just enough by the interposed metallic members to permit the full application of the pressure, whereupon the heat is conducted rapidly through the caul members to the assembly so that there is no further delay in the heating of the adhesive material at the glue lines. In the practice of this feature of the invention, and as exemplified in Fig. 11, a metal caul 140 may be first laid upon a conveyor such as 141, a back 138 disposed thereupon, and the upper surface of this ply coated as by being moved under a disseminating arrangement such as an atomizer 142, a rotating brush 143 and an atomizer 144. A core 136 is thereupon disposed on the back 138 and the assembly similarly completed by coating the partial assembly and disposing a face 137 thereon. A metallic caul member 139 is finally disposed on top of the face 137. The completed arrangement may then be delivered to suitable hot press mechanism and thereupon pressed. For example, it may be moved between endless belt pressure members 145 and 146 for which suitable heating means are provided.

As another example of a manner of providing a coating of a powdered adhesive material on surfaces to be joined, mention may be made of passing a surface to be glued through a mass of adhesive particles. For instance, (Fig. 13) a pair of narrow belts 147 and 148 may be arranged to grip the edges of a core 149 and pass it into and through a mass or heap 150 of particles in such manner that the particles will adhere to the sides of the core. The surfaces of the core are preferably moistened and the particles of the mass maintained in a dry state. After the core has been moved through the mass, face and back plies

may be associated with the coated surfaces thereof in any suitable manner and the assembly passed to pressing means in a desirable manner, such, for example, as one of the manners exemplified herein.

To further facilitate an understanding of the manner in which the time, temperature, and pressure or moisture content factors may be desirably controlled in a particular operation conducted in accordance with the invention, there is given below data for one mode of procedure in providing three-ply panels from rotary cut, yellow birch plies, each one-sixteenth inch thick, in a commercially dry state, each ply measuring 38 inches by 90 inches.

Character of adhesive material-----	50 parts casein— 50 parts dry spray process blood— 10 parts lime	80 mesh 75
Amount of adhesive material per 1,000 square feet of double glue line area-----	19½ pounds	85
Amount of water per 1,000 square feet of double glue line area-----	37 pounds	
Time interval between the starting of initial coating of a ply in an as- sembly and the completion of the assembly-----	1 minute and 30 seconds	90
Time interval between the completion of an assembly and the initiation of the bonding operation-----	30 seconds	
Pressure applied-----	200 pounds per square inch	95
Temperature at the face of the pressure elements-----	258° F.	
Duration of the bonding operation-----	1 minute	
Time interval between the completion of the bonding operation and the initiation of a succeeding finishing operation-----	5 minutes	100

Panels made up by a procedure conducted in accordance with the invention under the conditions set forth immediately above, wherein two plies of each assembly were coated on a surface, and wherein each of these plies was first passed through a spray from which it received 9½ pounds of water per thousand square feet of area coated, then through a zone wherein it received 9¾ pounds of the dry adhesive set forth per thousand square feet of area coated, and then through a spray wherein it received 9 lbs. of water per thousand square feet of area coated, showed an average of 470 pounds in dry shear tests, and an average of 269 pounds in wet shear tests after soaking for 48 hours in cold water.

By way of example, further reference is made to a continuous type of operation wherein the surfaces to be assembled are moved along progressively while moisture is applied, if necessary, and the adhesive material dusted on, an assembly conveyor adjusting the rate of travel such that the adhesive base is supplied to a first layer and moisture, if necessary, and the next layer or ply superposed in transit, adhesive base supplied and moisture, if necessary. Another assembly layer is superposed and then the assembly is passed through a heat and pressure applying zone,

as for instance, hot rollers or heated caterpillar type belts, for example. Reference is made to one instance wherein dry fir-wood veneer is fed to an assembly conveyor and is carried along under an atomizer, and water applied in a fine spray to the exposed surface, the amount of water being about 25 to 30 lbs. per square foot of ply surface. The ply surface is next carried under a distributor for powdered adhesive, a dry composition of 52.5 parts soluble blood albumen and 57.5 parts soya bean flour, 17 parts of hydrous trisodium phosphate crystals, and 15 parts of hydrated lime being dusted on as the surface travels along. The composition may be ground to about 80 mesh and spread at a rate of 20 to 25 lbs. per thousand square feet of ply surface. Another ply is superposed on this prepared surface, moisture is supplied by a further atomizer head, and then an adhesive applicator dusts on the adhesive, and another wood ply is in turn superposed. The assembly is then forwarded through a heat and pressure applying zone in the form of opposed caterpillar type belts and about two minute treatment is had at 270° F., and a pressure of about 200 lbs. during transit. The panels then proceed through a cooling zone and into a double deck sanding machine to sand and smooth down the surfaces. Edge-trimming completes the product, and the panels may then be sorted on a sorting and grading conveyor.

There is thus provided a continuous procedure utilizing blood in connection with soya bean flour, by means of which ply wood may be produced in a particularly efficient and effective manner under desirable conditions and with a relatively high degree of uniformity in the product. Since the soya bean flour is an adhesive material of a non-dispersible character, the penetration of the blood is desirably controlled as set forth in applicant's copending application, Serial #455,978, above referred to. As there set forth, other adhesives may be substituted for those specified. For example, soya bean flour may be replaced by other oil seed flours, by isolated protein therefrom, or by casein.

In similar continuous procedure, adhesive bases of different composition may also be employed. For instance a protein also in non-dispersed or discrete particle form, as soya bean flour 100 parts, with trisodium phosphate 10 parts, barium hydroxide 20 parts, and calcium hydroxide 17½ parts. The surfaces to be glued are supplied with the adhesive base in discrete particle form, and the assemblage may be passed through the hot-pressing zone for instance for one to three minutes. If the sodium salt be omitted, the longer period of heating is desirable in order to attain water-resistance. A good bond is had in either case.

For the sake of facility of expression the

term "squares" is utilized herein to describe plies which are sufficiently short so that they may be readily handled without rolling or unrolling, regardless of their geometric shape.

Since certain changes in carrying out the above methods and in the constructions set forth, which embody the invention may be made without departing from its scope, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

It is also to be understood that the following claims are intended to cover all of the generic and specific features of the invention herein described, and all statements of the scope of the invention which, as a matter of language, might be said to fall therebetween.

Having described my invention, what I claim as new and desire to secure by Letters Patent is:

1. The method of forming plywood, which comprises continuously supplying an adhesive material in discrete-particle form and in uniform quantities to be received by moving squares, moving squares along a path such that a surface of each square will receive said material during its movement, successively forming assemblies by a step which includes associating a square with the coated surface of each square which has so received said material, the sequential coating and associating steps being uniformly timed, and subjecting the completed assemblies to bonding conditions.

2. The method of forming plywood, which comprises continuously supplying an adhesive material in discrete-particle form and in uniform quantities to be received by moving squares, moving a series of squares one after another along a path such that a surface of each square will receive said material during its movement, successively forming assemblies by a step which includes associating one of another series of squares with the coated surface of each square which has so received said material, the sequential coating and associating steps with respect to each of the squares of the first mentioned series being uniformly timed and each of said assemblies being completed in a uniform time interval, and subjecting each of the assemblies to bonding conditions for a uniform time interval.

3. The method of forming plywood, which comprises continuously supplying an adhesive material in discrete-particle form and in uniform quantities to be received by moving squares, moving a series of squares one after another along a path such that a surface of each square will receive said material during its movement, successively forming assemblies by a step which includes associating one of another series of squares with the

coated surface of each square which has so received said material, the sequential coating and associating steps with respect to each of the squares of the first mentioned series being uniformly timed, initiating a bonding step with respect to each of said completed assemblies at uniform time intervals after the coating of their respective ones of the squares contained in the first mentioned series, and continuing the bonding operation with respect to each of said assemblies for a uniform time interval.

4. The method of forming plywood, which comprises continuously supplying an adhesive material in discrete-particle form and in uniform quantities to be received by moving squares, moving a series of squares one after another along a path such that a surface of each square will receive said material during its movement, there being suitably provided a liquid whereby the adhesive will be affected in situ successively forming assemblies by a step which includes associating one of another series of squares with the coated surface of each square which has so received said material, initiating a bonding step with respect to each of said completed assemblies at a time not greater than 5 minutes after the coating of the square of the first-mentioned series contained therein and less than sufficient to complete the effect of the liquid on the adhesive.

5. The method of forming plywood, which comprises continuously supplying an adhesive material in discrete-particle form and in uniform quantities to be received by moving squares, moving a series of squares one after another along a path such that a surface of each square will receive said material during its movement, successively forming assemblies by a step which includes associating one of another series of squares with the coated surface of each square which has so received said material, the sequential coating and associating steps with respect to each of the squares of the first mentioned series being uniformly timed, subjecting each of said assemblies to heat and pressure at a uniform time interval after the coating of the respective ones of the squares contained in the first-mentioned series, and maintaining each of said assemblies under heat and pressure for a uniform time interval under conditions such that the quantity of vaporizable material in the pressed panel is not reduced a substantial amount below the quantity of vaporizable material in the original squares.

6. The method of forming plywood, which comprises concurrently supplying a heat settable adhesive material in discrete-particle form to surfaces to be united and assembling surfaces to be united in the presence of vaporizable material, and subjecting the assembled surfaces to heat and pressure for a period not substantially exceeding one minute, the heat

applied being sufficient to set the adhesive but insufficient to generate bursting pressures within the assembly great enough to rupture the bond upon the release of pressure, said operations being conducted under conditions such that the quantity of vaporizable material in the pressed panel is not reduced a substantial amount below the quantity of vaporizable material in the original plies.

7. The method of forming plywood, which comprises continuously supplying an adhesive material in discrete-particle form and in uniform quantities to be received by moving squares, moving a series of squares one after another along a path such that a surface of each square will receive said material during its movement, successively forming assemblies by a step which includes associating one of another series of squares with the coated surface of each square which has so received said material, each of said assemblies being completed in a uniform time interval, and moving each of said completed assemblies to bonding mechanism, each of said movements occupying a predetermined time interval after the initial coating of a square contained therein, and subjecting each assembly to bonding conditions for a uniform time interval.

8. The method of forming plywood, which comprises continuously supplying an adhesive material in discrete-particle form and in uniform quantities to be received by moving squares, moving a series of squares one after another along a path such that a surface of each square will receive said material during its movement, successively forming assemblies by a step which includes setting another square upon each coated square at a given point in its movement along said path, and subjecting the completed assemblies to bonding conditions.

9. The method of forming plywood, which comprises continuously supplying an adhesive material in discrete-particle form and in uniform quantities at a position to be received by moving squares, moving a series of squares one after another along a path such that a surface of each square will receive said material during its movement, associating with each coated square as its movement continues one of a series of other squares to form a partial assembly, continuously supplying adhesive material in discrete-particle form and in uniform quantities at a position to be received by moving partial assemblies, moving said partial assemblies one after another as they are formed along a path such that a surface of each partial assembly will receive material at said second-mentioned position, completing each assembly, and thereafter subjecting each assembly to heat and pressure, the heat and pressure applied to the two sides of each assembly being uniform.

10. The method of forming plywood, which comprises continuously supplying an adhesive material in discrete-particle form and in uniform quantities at a position to be received by moving squares, moving a series of squares one after another along a path such that a surface of each square will receive said material during its movement associating with each coated square as its movement continues one of a series of other squares to form a partial assembly, continuously supplying adhesive material in discrete-particle form and in uniform quantities at a position to be received by moving partial assemblies, moving said partial assemblies one after another as they are formed along a path such that a surface of each partial assembly will receive material at said second mentioned position, completing each assembly, each assembly being completed in a uniform time interval, moving each completed assembly to a bonding mechanism, each movement occupying a predetermined time interval after the initial coating of a square contained therein, and subjecting each assembly to bonding conditions for a uniform time interval.

11. The method of forming plywood, which comprises continuously and concurrently applying an adhesive material in discrete-particle form to the surfaces of the squares to be united and assembling such surfaces, each assembly being built up on one of a series of squares moving one after another at a given speed, moving each assembly at a higher speed after its completion to separate said assemblies, delivering each of the assemblies thus separated to non-progressive bonding mechanism in a uniform time interval after the initial coating of a square contained therein, and subjecting each assembly to bonding conditions for a uniform time interval without movement of the assembly.

12. The method of forming plywood, which comprises moving a series of squares one after another along a given path, applying an adhesive material in discrete-particle form to each of said squares at a given point in said path, disposing another square on each coated square at a second point in said path, performing successive coating and assembly operations at successive points in said path, moving each completed assembly at a higher speed at a further point in said path to separate the assemblies, delivering each of the assemblies thus separated to non-progressive bonding mechanism in a uniform time interval after the initial coating of a square contained therein, and subjecting each of said assemblies to bonding conditions for a uniform time interval without movement of the assembly.

13. The method of forming plywood, which comprises continuously supplying an adhesive material in discrete-particle form in uni-

form quantities at a position to be received by moving squares, moving a series of squares one after another along a path such that a surface of each square will receive said material during its movement, successively forming assemblies by a step which includes associating with each coated square one of another series of squares, moving the assemblies so formed one after another in uniform time intervals after the initial coating of a square contained therein between pressure elements, and progressing the assemblies along between said pressure elements for a sufficient period and under conditions to effect the bonding of the squares.

14. The method of forming plywood which comprises disposing of a series of squares one after another upon a conveyor, applying an adhesive material in discrete-particle form and to successive squares as they move along on the conveyor, setting each of another series of squares one after another upon successive coated squares at a predetermined point in the motion thereof on the conveyor, completing each partial assembly thus formed, and progressing each assembly after it is formed between heated pressure elements for a period of time sufficient to bond the squares to form a completed panel.

15. The method of forming plywood which comprises continuously supplying an adhesive material in discrete-particle form in uniform quantities at a position to be received by moving squares, moving a series of squares at a given speed one after another along a path such that a surface of each square will receive said material during its movement, successively forming assemblies by a step which includes setting one of an additional series of squares upon each coated square at a given point in its movement, continuing the movement of each assembly to a point where it passes between pressure elements, and progressing each assembly along between said pressure elements for a sufficient period to effect the desired bonding, said progression being at the same speed as the aforesaid movement.

16. The method of forming plywood, which comprises continuously supplying adhesive material in discrete-particle form and in uniform quantities to be received by squares, causing squares to receive coatings of said material, and successively forming assemblies, said operations being conducted in a continuous and concurrent manner wherein an assembly of squares is being formed while another square is being coated, and the successive coating and assembly steps being uniformly timed.

17. The method of forming plywood, which comprises moving along a given path one after another a series of plate-like elements, each of which is a good conductor of heat,

building up an assembly of relatively poor heat-conducting squares on each of said plate-like elements during its movement, and subjecting each completed arrangement to heat and pressure.

18. The method of forming plywood which comprises moving along a given path one after another a series of plate-like elements each of which is a good conductor of heat, building up an assembly on each of said plate-like elements during its movement, disposing an additional plate-like element on each assembly, and subjecting each completed arrangement to simultaneously applied heat and pressure.

19. The method of forming plywood, which comprises continuously and concurrently applying to a surface of commercially dry squares an adhesive material in discrete-particle form and a plasticizing agent and forming assemblies each including at least one of said squares, said plasticizing agent being in an amount not greater than the equivalent of twenty-five pounds of water to one thousand square feet of glue line area, conducting each assembly as it is formed to a pressing mechanism and immediately applying heat and pressure thereto, each of said assemblies being subjected to heat and pressure at a uniform time after the initial coating of a square contained therein and being subjected to heat and pressure for a uniform time interval.

20. The method of forming plywood which comprises supplying at a glue line between surfaces of materials having no excess of moisture an adhesive material in discrete-particle form, and also supplying a plasticizing agent in an amount not substantially in excess of the amount required for effecting the union, subjecting the adhesive material at the glue line to heat and pressure, and continuing the application of heat and pressure for a period not exceeding 1 minute.

21. The method of forming plywood which comprises associating surfaces to be joined in the presence of an adhesive material in discrete-particle form and a plasticizing medium in a proportion not greater than an equivalent of 30 pounds of water to one thousand square feet of glue line area, and subjecting said surfaces to heat and pressure.

22. The method of forming plywood, which comprises associating surfaces to be joined in the presence of an adhesive material in discrete-particle form and a liquid in a proportion not greater than an equivalent of 25 pounds of water to 1,000 square feet of glue line area, and subjecting said surfaces to heat and pressure.

23. The method of forming plywood, which comprises applying adhesive material in discrete particle form to a surface to be incorporated, a liquid being also applied in a proportion not greater than an equivalent of 25 pounds of water to 1,000 square feet of

surface area, assembling and subjecting to heat and pressure.

24. The method of forming plywood, which comprises applying adhesive material in powdered form to a surface to be incorporated, a liquid being also applied in a proportion not greater than an equivalent of 25 pounds of water to 1,000 square feet of glue line area and being applied in part before the application of the adhesive material and in part after its application, assembling and subjecting to heat and pressure.

25. The method of forming plywood which comprises continuously and concurrently applying an adhesive material in discrete-particle form to squares and forming assemblies including said squares, subjecting each assembly to bonding conditions after an interval not greater than 5 minutes after the initial coating of a square included therein, and continuing said bonding operation for a period not exceeding 1 minute.

26. The method of gluing materials which comprises applying a plasticizing agent to a surface to be glued, thereafter applying an adhesive material in powdered form to said surface, and thereafter applying a plasticizing liquid to said surface, and associating with the coated surface a surface to be joined thereto.

27. Apparatus for the formation of plywood comprising a conveyor for plies, means for applying a plasticizing liquid to plies moving on said conveyor, means for applying a powdered adhesive material to plies moving on said conveyor, and a second means for applying a plasticizing liquid to plies moving on said conveyor, said applying means being arranged to operate in the order named.

28. Apparatus for the formation of plywood, including spreading means arranged to disseminate powdered adhesive material, conveyor means for moving a square in position to receive on a surface thereof material from said spreading means, means to set a square on said conveyor means, means to convey the coated square away from said spreading means, means to dispose a second square upon the coated surface of a square being moved away from said spreading means, and bonding mechanism for receiving the assemblies thus formed.

29. Apparatus for the formation of plywood, including spreading means arranged to disseminate powdered adhesive material, conveyor means for moving a square in position to receive on a surface thereof material from said spreading means, means to set a square on said conveyor means, means to convey the coated square away from said spreading means, means to set a second square upon the coated surface of a square being moved away from said spreading means, a second spreading means arranged to disseminate powdered adhesive material, means to

move a partial assembly formed by the previously mentioned means in position to receive an adhesive material from said second spreading means upon a surface thereof, means to convey the coated partial assembly away from said second spreading means, means to set a third square upon the coated surface of a partial assembly being moved away from said second spreading means, and bonding mechanism for receiving assemblies thus formed.

30. Apparatus for the formation of plywood, including spreading means arranged to disseminate powdered adhesive material, conveyor means for moving a square in position to receive on a surface thereof material from said spreading means, means to set a square on said conveyor means, means to convey the coated square away from said spreading means, means to set a second square upon the coated surface of a square being moved away from said spreading means, a second spreading means arranged to disseminate powdered adhesive material, means to move a partial assembly formed by the previously mentioned means in position to receive an adhesive material from said second spreading means upon a surface thereof, means to convey the coated partial assembly away from said second spreading means, means to set a third square upon the coated surface of a partial assembly being moved away from said second spreading means, and bonding mechanism for receiving assemblies thus formed, said bonding mechanism being adapted to receive said assemblies one at a time and to progress them along as the bonding operation progresses.

31. Apparatus for forming plywood, comprising means for conveying squares, automatic means for setting squares successively and in close juxtaposition on said conveying means adjacent the beginning of its active run, means beyond said setting means for disseminating a powdered adhesive material above said conveying means, means beyond the disseminating means for setting another square upon each coated square, a second means for disseminating a powdered adhesive material above said conveying means at a point beyond the last-mentioned means, means beyond said second disseminating means for setting an additional square upon each coated partial assembly, and means for subjecting to bonding conditions assemblies formed by the preceding means.

32. Apparatus for forming plywood, comprising means for conveying squares, automatic means for setting squares successively and in close juxtaposition on said conveying means adjacent the beginning of its active run, means beyond said setting means for disseminating a powdered adhesive material above said conveying means, means beyond the disseminating means for setting another

square upon each coated square, a second means for disseminating a powdered adhesive material above said conveying means at a point beyond the last-mentioned means, means beyond said second disseminating means for setting an additional square upon each coated partial assembly, and a continuous pressing mechanism disposed beyond the aforesaid mechanism and arranged to progress the assemblies therethrough at a speed similar to the speed of movement of the conveyor.

33. The method of forming plywood, which comprises successively applying an adhesive material in discrete particle form to the surfaces of squares while progressing them along, forming assemblies embodying coated squares concurrently with the coating of other squares, and subjecting the assemblies to bonding conditions concurrently with the formation of other assemblies, the period between the initial coating of a square contained in an assembly and the completion of the assembly being uniform for all assemblies.

34. The method of forming plywood, which comprises successively applying adhesive material in discrete-particle form to the surfaces of squares while progressing them along, a liquid being applied in an amount not greater than 25 pounds per 1,000 square feet of glue line area, forming assemblies embodying coated squares concurrently with the coating of other squares, and subjecting the assemblies to bonding conditions concurrently with the formation of other assemblies, the period between the initial coating of a square contained in an assembly and the completion of the assembly being uniform for all assemblies.

35. The method of forming plywood, which comprises progressing a series of squares one after another along a path, applying adhesive material in discrete-particle form and in uniform amount to said squares at one stage of their travel along said path, disposing an additional square upon each coated square at a further stage in its travel, applying to the exposed surface of each second square adhesive material in discrete-particle form and in a uniform amount at a further stage in the travel of said squares along said path, disposing a third square upon each second square at a further stage of travel of said squares along said path, and subjecting assemblies to bonding conditions at a still further stage in the travel of said squares along said path.

36. The method of forming plywood, which comprises applying adhesive material in discrete-particle form to the surfaces of squares, a liquid being provided, forming assemblies each including at least one of said coated squares, and subjecting each of the assemblies to bonding conditions, the time

between the initial application of adhesive material to a square contained in an assembly and the initiation of the bonding operation being uniform with respect to such time in connection with the other assemblies.

37. The method of forming plywood, which comprises applying adhesive material in discrete-particle form to the surfaces of squares, a liquid being provided in an amount not greater than 25 pounds per 1,000 square feet of glue line area, forming assemblies each including at least one of said coated squares, and subjecting each of the assemblies to bonding conditions, the time between the initial application of adhesive material to a square contained in an assembly and the initiation of the bonding operation being uniform with respect to such time in connection with the other assemblies.

38. The method of forming plywood, which comprises applying adhesive material in discrete-particle form to the surfaces of squares, a liquid being provided, forming assemblies each including at least one of said coated squares, and subjecting each of the assemblies to bonding conditions, the time between the initial application of adhesive material to a square contained in an assembly and the initiation of the bonding operation being uniform with respect to such time in connection with the other assemblies, and being insufficient to permit the liquid to exert its full effect.

39. The method of forming plywood, which comprises applying adhesive material in powdered form to the surface of a square, a plasticizing liquid being provided independently of the adhesive, disposing another square on the coated square, and subjecting an assembly including said squares to pressure and heat, the time between the initial coating of a square contained in said assembly and the initial application of pressure and heat being not greater than five minutes, and the application of pressure and heat being for a period not substantially exceeding one minute.

40. The method of forming laminated structures, each containing a multiplicity of wood plies, which comprises utilizing in the formation of each structure plies having a combined moisture content of materially less than 10% of the weight of the structure, applying to one of each pair of surfaces to be incorporated in each structure an adhesive material in discrete-particle form, supplying also moisture in a total amount not substantially exceeding the difference between said combined moisture content and 10% of the weight of the structure, assembling and subjecting to heat and pressure.

41. The method of forming plywood, which comprises continuously and concurrently applying powdered adhesive material and liquid to surfaces of commercially dry

squares and forming assemblies each including at least one of said squares, said liquid being in an amount not greater than the equivalent of twenty-five pounds of water to one thousand square feet of glue line area, and subjecting each assembly to pressure and heat, the initiation of the bonding of no assembly being spaced more than five minutes after the initial coating of a square contained therein.

42. The method of forming plywood, which comprises applying adhesive material in discrete-particle form to a surface to be incorporated, a liquid being also applied in a proportion not greater than an equivalent of 25 pounds of water to 1,000 square feet of surface area, assembling and subjecting to heat and pressure after an interval not greater than 5 minutes after the application of the adhesive material.

In testimony whereof I affix my signature.
THEODORE WILLIAMS DIKE.