

Oct. 20, 1953

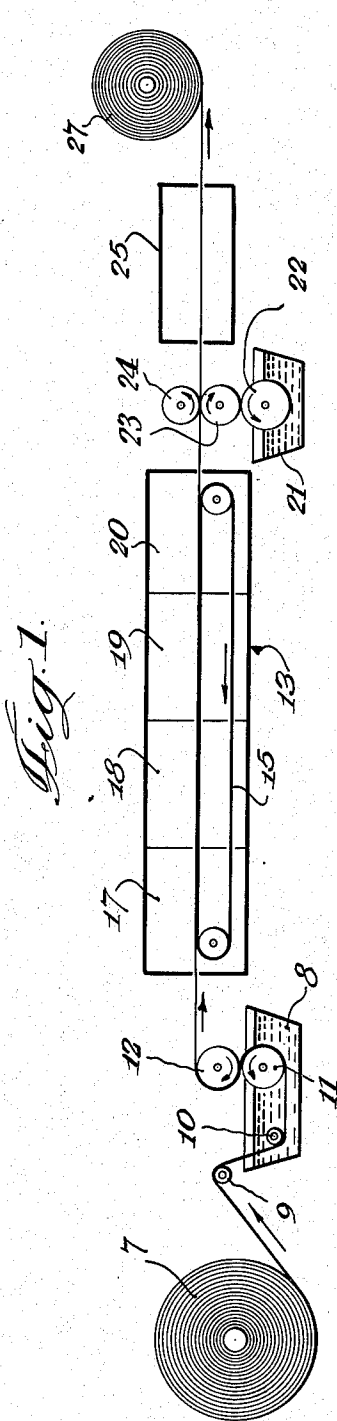
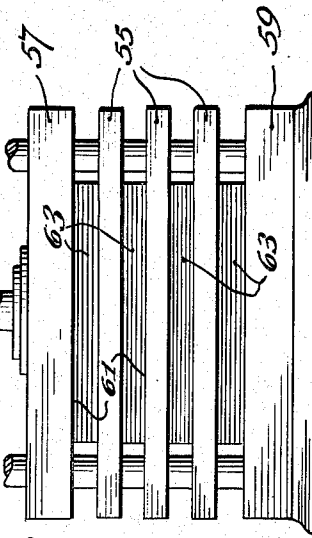
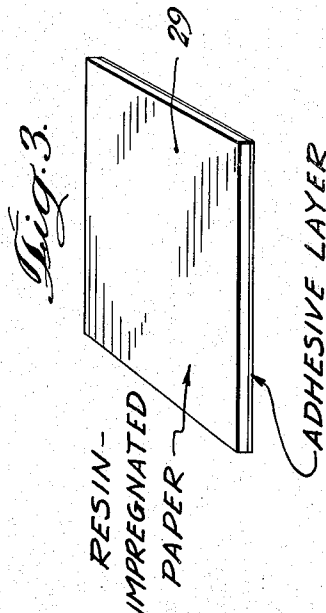
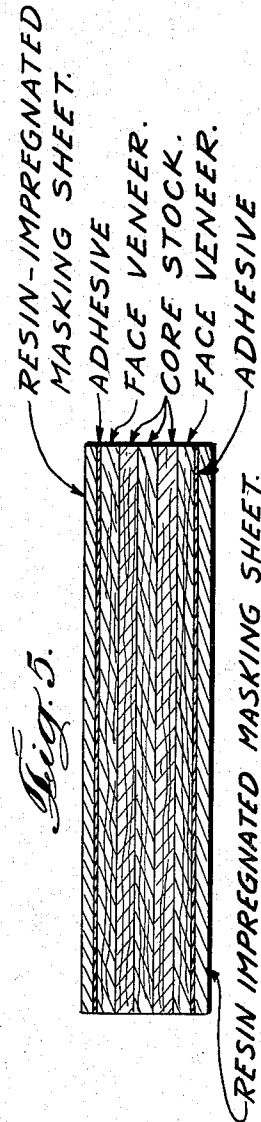
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2,656,296

PROCESS OF MANUFACTURING FIBROUS SHEET COVERED PLYWOOD

Filed June 5, 1951

3 Sheets-Sheet 1



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3 Sheets-Sheet 2

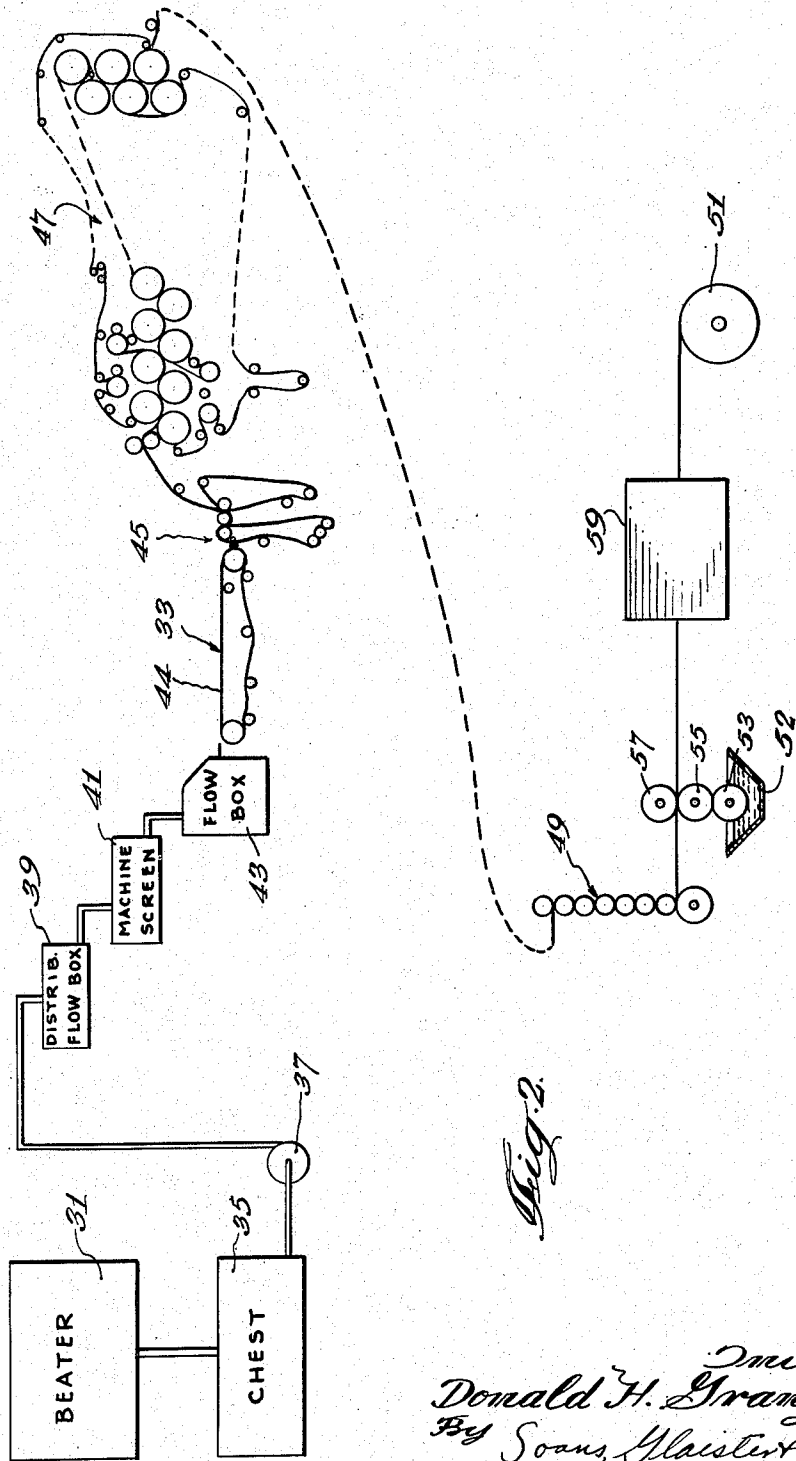


Fig. 2.

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3 Sheets-Sheet 3

Fig. 6.

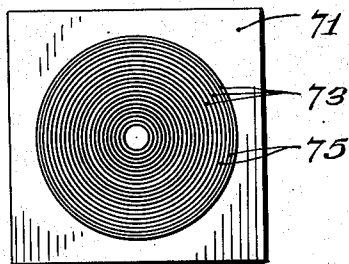
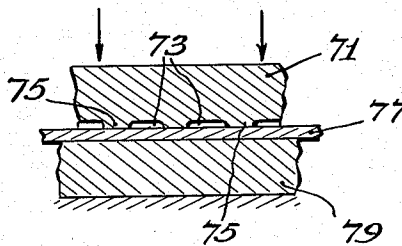


Fig. 7.

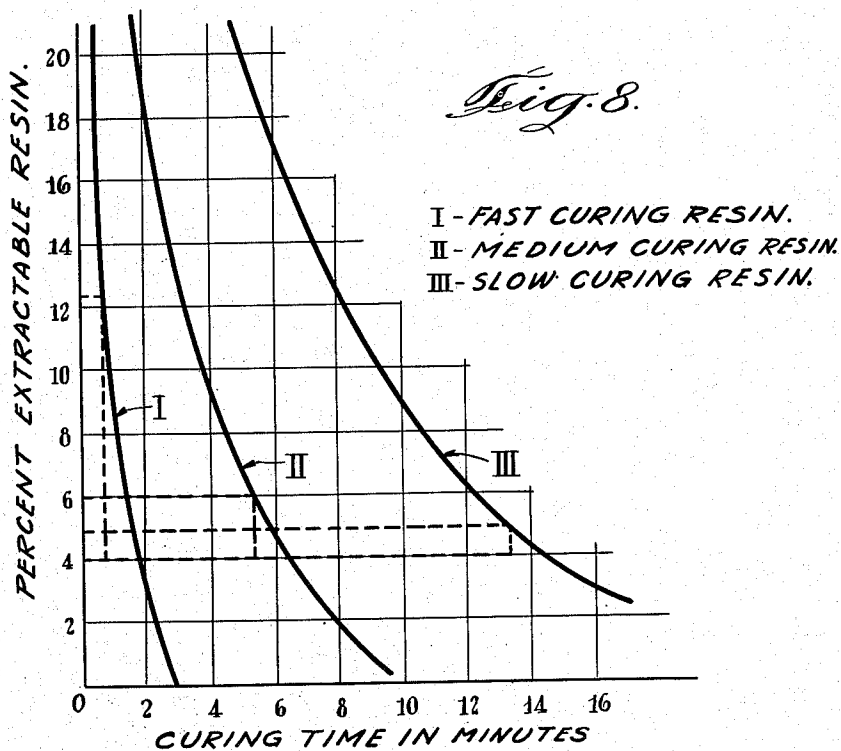


Fig. 8.

I - FAST CURING RESIN.
II - MEDIUM CURING RESIN.
III - SLOW CURING RESIN.

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UNITED STATES PATENT OFFICE

2,656,296

PROCESS OF MANUFACTURING FIBROUS
SHEET COVERED PLYWOODDonald H. Grangaard, Appleton, Wis., assignor to
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Application June 5, 1951, Serial No. 229,951

4 Claims. (Cl. 154—132)

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The present invention relates generally to the manufacture of plywood and similar sheet materials, and has for its principal object the improvement of the surface characteristics of these materials, especially plywood made from Douglas fir.

As will hereinafter appear, this object is accomplished by the provision of a masking or cover sheet of novel type, which is adapted to be attached to the sheet material with which it is used so as to constitute the exposed surface thereof.

Very large amounts of plywood are manufactured and used each year in the United States for buildings and for other purposes, and a large portion of this plywood is made from Douglas fir. This wood has the advantages of being strong and relatively inexpensive, while at the same time being comparatively easy to fabricate. Douglas fir plywood has, however, certain very important disadvantages. Particularly, it is difficult to obtain logs which are completely free from knots or other blemishes, and as a result, the available surface veneers frequently contain relatively large knot holes, pitch pockets or other defects. Moreover, even when it is possible to obtain a substantially perfect surface ply, Douglas fir is subject to checking and to very severe grain-raising, both of which render the obtaining of a smooth, grain-free finish on the plywood surface almost impossible.

The phenomenon of grain-raising is caused by the variation in density in the wood due to differing rates of growth in the spring and summer growth periods. The differing densities in the wood result in differing rates of expansion or contraction with change in moisture content, and the grain becomes clearly visible on the face of the sheet or panel. This is especially objectionable in cabinets, doors, etc., which are to be subsequently painted, or finished, with a glossy paint or enamel.

Checking is evidenced by relatively short, hair line cracks, the cracks developing most rapidly when the face veneer is dried out, a condition which commonly occurs in the interior of houses, etc., when the relative humidity is low. In aggravated cases, the wood may actually split. It is not possible to completely prevent or overcome checking or splits by painting, enameling, or other finishing methods, and these defects appear as cracks in the finish.

The defects resulting from knots, pitch pockets, and the like are corrected by the use of plug patches, the most commonly used types being

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known as "cookie" patches and "boat" patches. In the use of plug patches, a hole is cut or punched from the wood sheet or veneer of sufficient size to include the entire defective area, and an insert of similar shape, which has been cut from a perfect sheet, is inserted in the cut-out. These inserts are, however, clearly visible in the completed plywood sheet, and since at least the outline will show through paint or other finishes, they have the effect of lowering the quality of the sheet. To this extent, the defects resulting from the use of plug patches are most serious, from an economic viewpoint, because a plywood sheet which contains any visible defects on either surface must be sold as a lower grade sheet than one which is completely free from defects.

In the practice of the present invention, a sheet of resin containing paper is applied to the exposed surface of the plywood. This resin-bearing sheet has certain very definite requirements and characteristics, as will hereinafter appear, and when applied to the plywood surface, it effectively masks all of the ordinary surface defects, including raised grain, ordinary checking and small splits, and both cookie and boat type plug patches. The principal object of the invention is thus accomplished and a smooth finish, free from grain or other imperfections is obtained on the plywood or other sheet material with which the masking sheet is used.

The present application is a continuation-in-part of my prior abandoned applications Serial No. 779,889, and Serial No. 116,810, which were filed on October 15, 1947, and September 20, 1949, respectively, and which were assigned to the assignee of the present invention. In those applications I have disclosed certain particularly satisfactory masking sheets which are likewise capable of accomplishing the above stated principal object of the invention. More particularly, the earlier filed application, Serial No. 779,889, is principally directed to masking sheets containing resins of the phenol-aldehyde type, while the second application, Serial No. 116,810, is concerned primarily with masking sheets containing resins of the urea-aldehyde type.

This application combines the disclosures of these two prior applications, and includes, in addition, certain extensions of, and additions to, the disclosures made in these said applications, particularly with regard to the addition of the resin to the sheet. Hence, a further object of the present invention is to provide improved methods of manufacturing resin-containing ply-

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wood masking sheets, in accordance with the general principle disclosed in my said applications Serial No. 779,889 and Serial No. 116,810. A still further, and even more specific object of the invention is to produce a masking sheet of this type which contains one or more of the beater addition resins, alone or in combination with one or more other resins and which, at the same time, has very high wet abrasion and scuff resisting surfaces.

In Figure 1 of the drawings, there is a schematic illustration of a method of manufacturing the improved cover or masking sheet of the invention;

Figure 2 shows, in schematic illustration, another method of manufacturing the improved masking sheet of the invention;

Figure 3 is an enlarged, fragmentary, perspective view, showing the completed masking sheet having a glue-line or adhesive applied thereto;

Figure 4 is a diagrammatic view of a plywood press and illustrates the manner in which masking sheets, in accordance with the invention, may be applied to the surfaces of the plywood panels;

Figure 5 is a sectional view illustrating a portion of a plywood panel with cover or masking sheets, in accordance with the invention, applied to both surfaces thereof;

Figure 6 is a plan view of a die member used in determining certain characteristics of the masking sheets of the invention;

Figure 7 is an enlarged, fragmentary, sectional view illustrating the manner in which the die member of Figure 6 is used; and

Figure 8 is a graph showing variation in the per cent of extractable resin with curing time for three representative types of masking sheets made in accordance with the present invention from a relatively slow, a medium, and a fast curing resin. The graph also illustrates a test procedure which will hereinafter be described in greater detail.

In the manufacture of the masking sheet of the present invention, resin is uniformly distributed throughout the sheet and this resin is then advanced to a high degree of cure, the advanced degree of cure being one of the important features of the invention. The resin may be uniformly distributed throughout a base sheet after that sheet has been formed, or, in the alternative, the resin may be introduced into the product by mixing a resin or resins with the pulp. The masking sheet may also be manufactured by distributing the resin or resins in the sheet by a combination of these methods.

When the resin is to be introduced into a preformed sheet, a base sheet of rather heavy, moderately absorbent paper may be passed through resin applying means so as to effect uniform distribution of resin throughout that sheet. The resin-bearing sheet may then be moved through drying and curing ovens to accomplish controlled curing of the resin. Following the curing operation, the resin bearing sheet may be conducted through a cooling zone, after which an adhesive coating may be applied to one surface thereof for the purpose of providing a glue line. As a final step, the glue line, if used, should be dried to a non-tacky condition.

If all, or part of, the resin is to be impregnated in the masking sheet as an incident to the manufacture of the base sheet, a beater-addition type resin, which has relatively rapid curing characteristics, is introduced into the paper furnish, preferably at the beater, the resin being in either

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liquid or solid form. When this is done, the beater thoroughly disperses and uniformly distributes the resin throughout the pulp fiber. The furnish is then pumped to a conventional type paper-making machine, such as a Fourdrinier machine, and formed into a sheet. A glue line may be applied to the sheet at the end of the paper making operation and, if the glue line is used, it is dried sufficiently to produce a non-tacky condition as a final step in the formation of the masking sheet of the invention.

Regardless of the particular method employed to effect the introduction of resin into the sheet, it is important that the resin shall be uniformly distributed throughout the sheet, and that it shall be cured to the extent to be hereinafter defined. When this is done, the sheets resulting from any of these methods will have excellent masking characteristics. In this connection, it should be noted that the preferred methods of manufacturing resin-bearing masking sheets in accordance with the invention do not use pressure for the purpose of advancing the resin cure, and that the resin cure is advanced to a high degree prior to any use of the masking sheet. The latter characteristic of the invention is of significance for the reason that it is contrary to the commercial practice of preparing resin-bearing laminates and, indeed, has been carefully avoided heretofore.

The drawings illustrate two general types of apparatus for manufacturing the masking sheet of the invention, Figure 1 showing apparatus whereby the resin impregnation may be introduced into a preformed sheet and Figure 2 illustrating apparatus wherein resin may be introduced into a sheet of paper during the manufacture of that sheet. In the particular apparatus illustrated in Figure 1, a base sheet is contained on a supply roll, illustrated at 7, and this sheet is guided through a pan 8 which contains a solution of impregnating resin, by means of guide rolls 9 and 10. To assure that the proper amount of resin will be contained in the sheet, and to effect even resin impregnation and distribution, a pair of squeeze rolls 11 and 12 are arranged to engage the base sheet as it emerges from the bath of resin. The squeeze rolls 11 and 12 are desirably adjustably supported in order that the amount of resin retention in the base sheet can be accurately controlled. After leaving the squeeze rolls 11 and 12, the sheet is conveyed through an oven 13 by means of a belt conveyor 15. The oven 13 includes three separate heating sections 17, 18 and 19, which are adapted to be maintained at different interdependently controlled temperatures, in order that the drying and curing of the resin impregnated sheet can be accurately controlled. The oven 13 also includes a fourth or cooling section 20, which may be provided with fans or cooling coils, or both, for effecting cooling of the sheet in a short interval of time. The provision of a cooling zone immediately following the heated, curing zones, also aids in securing accurate control of the curing operation. It will be understood that other means and procedures can be employed for incorporating the resin into the sheet and for effecting the curing of the same.

In the apparatus illustrated in Figure 1, a glue line adhesive is applied to one face of the cured, resin-bearing sheet immediately after it leaves the oven 13. The means for accomplishing this includes a pan 21 for containing the adhesive in liquid form, a dip roll 22 and a pair of squeeze

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rolls 23 and 24. After passing through the adhesive applying means, the sheet is conducted through a second heated oven 25, wherein the coating is dried. Following this, the completed sheet product may be reeled up on a take-up reel, as indicated at 27.

The glue line adhesive can be applied as a completely separate operation, or it may be omitted entirely. In some instances, it will be found more desirable to apply the adhesive for joining the masking sheet to the surface of the plywood or other product with which the sheet is used at the time that the sheet is to be attached and the adhesive may then be applied to the wood rather than to the masking sheet, or a separate sheet or film of the adhesive may be used in accordance with the known practices of the art.

The base sheet used in apparatus of the type shown in Figure 1 preferably comprises a 100% kraft sheet. However, satisfactory sheets can be manufactured from pulp furnishes of other types, for example, sheets manufactured from sulphite pulp, semi-chemical pulp, groundwood-sulphite mixtures, etc., such sheets giving good results in most instances. The particular pulp or pulp mixture used will depend to some extent upon the handleability conditions required in the final sheet and upon the degree of scuff and abrasion resistance required in the end product.

Investigations have shown that the base sheet should have a basis weight when dry within the range of from about 110 to 210 pounds per standard ream, 500 sheets 24 by 36 inches (bone dry basis), with a density within the range of from about .55 to .80 gram per cubic centimeter and that the optimum sheet has a dry basis weight within the range of from about 125 to 135 pounds per standard ream, at densities within the range of from .65 to .75 gram per cubic centimeter. If the density is too low, the resulting masking sheet will lack abrasion or scuff resistance, and if the density is too high, it will become unduly difficult to accomplish the particular kind of resin impregnation that is required in the attaining of the objects of the invention. Generally stated, the base sheet should be a relatively dense sheet which, at the same time, is absorbent. The heavier basis weight sheets tend to give better masking, but sheets having basis weights materially greater than the optimum range specified are uneconomical.

The caliper or thickness of the base sheet may vary between rather wide limits, but the caliper is desirably in the range of from about 10 to 13.5 thousandths of an inch. The pH of the base sheet is not particularly important, although it will usually be found most convenient to operate with a base sheet which has a pH which is somewhat on the acid side, i. e. a pH in the range of from about 4.0 to 4.5. The tensile strength of the sheet is also not of too great importance, but it should be sufficiently great so that the sheet may be drawn through the impregnating apparatus without tearing or breaking.

In one particularly satisfactory embodiment of the invention the base sheet constituted a 100 per cent kraft sheet, having an unimpregnated basis weight of approximately 125 pounds per standard ream of 500 sheets 24 by 36 inches (bone dry basis). The sheet had an average caliper or thickness within the range of about 12.5 to 13.5 one-thousandths of an inch and a density within the range of from .56 to .65 gram per cubic centi-

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meter. The average net wet tensile strength of the sheet was about 10 pounds per inch of width.

The resin impregnating material used in the manufacture of this embodiment of the invention consisted of an aqueous solution of a phenol formaldehyde resin having high penetrability and low viscosity at the concentrations used for impregnating the sheet, and the actual impregnating solution had a solids content of approximately 25 per cent and a viscosity of about 50 centipoises at the impregnating temperature, which was within the range of from about 105° to 140° F. Elevated temperatures of this order are desirable during the impregnating operation in order to improve the penetration of the resin into the base sheet and to facilitate the subsequent drying operation.

After passage through the squeeze rolls 11 and 12, the impregnated sheet had a wet weight of approximately 365 pounds per standard ream. This resulted in a resin content in the final dry sheet, as it came from the oven 13, of approximately 55 pounds per standard ream, or a resin content of about 30.5 per cent, based on the finished total weight of the dry sheet.

In the oven 13, the initial zone 17 was maintained at a temperature of about 325° F. The temperature of the next succeeding zone 18 was approximately 350° F. and the temperature in the final heating zone 19 was maintained at approximately 375° F. The entire oven 13, excluding the cooling zone 20, had a length of approximately 100 feet, and the three heating zones were of equal length. The temperature in the cooling zone was maintained substantially equal to room temperature by the use of circulating fans. During the entire operation, the sheet was moved at a uniform speed within the range of from about 25 to 30 feet per minute. Under these conditions, the resin was dried and cured within the oven structure 13 to the highly advanced state which is required in carrying out the invention. A portion of a completed sheet is illustrated at 29 in Figure 3. It will be understood that the impregnating resin is distributed throughout the base sheet and that the glue line resin comprises a thin surface coating.

In another highly satisfactory embodiment of the invention urea-aldehyde resins were employed. Urea-aldehyde resins are either white or substantially colorless when cured, and when these resins are used, masking sheets which are light in color may be produced. Such masking sheets contrast with the relatively dark sheets which result from the use of phenol-aldehyde resin in the masking sheets. In order to obtain the maximum advantage from the use of urea-aldehyde resins, base sheets which are light in color should be employed, as for example, sheets which are made from unbleached sulphite pulp, bleached sulphite pulp, semi-chemical pulp, groundwood pulp, alpha sulphite pulp, soda pulp, and bleached kraft pulp, or mixtures thereof. Of course, sheets made from other pulps may be employed if the color of the sheets is not objectionable.

A masking sheet containing a urea-formaldehyde resin was produced by taking a selected base sheet made from all sulphite furnish (unbleached balsam sulphite) having a basis weight, when dried, of approximately 119 pounds per standard ream of 500 sheets, 24 by 36 inches (bone dry basis). The sheet possessed sufficient wet strength to enable it to be drawn through the impregnating bath and the drying oven, and

had an average caliper of approximately 11.5 one-thousandths of an inch and a density of about .87 gram per cubic centimeter. The base sheet possessed relatively high absorption, this being desirable for assuring uniform impregnation during the resin applying operation.

The resin-impregnating material used in the manufacture of the urea-formaldehyde sheet was prepared by adding to 1050 pounds by weight of formalin (37 per cent formaldehyde in water) 480 parts by weight of urea and 35 parts by weight of ammonium hydroxide, all at a temperature of about 65°-75° C. The mixture was allowed to stand for approximately two hours, and was then used for impregnating the base sheet, without further dilution or the addition of further materials. As used, the impregnating mixture had a solids content of approximately 50% and a viscosity of about one centipoise at the impregnating temperature, which was within the range of from about 100° to 170° F. After passage through the squeeze rolls 11 and 12, the sheets had a wet weight of approximately 220 lbs. per standard ream. This produced a resin content in the final dry sheet, as it came from the oven 13, of approximately 50.5 lbs. per standard ream, or a resin content of approximately 29.3%, based on the finished, total weight of the sheet when in a bone-dry condition.

The urea-formaldehyde containing sheet was dried and cured in accordance with the procedure outlined above in connection with the phenol-aldehyde impregnated sheet. However, the sheet was drawn through the oven 13 at a somewhat faster rate, the rate being in the range of from 36 to 40 feet per minute.

In the manufacture of another specific example of the invention, a base sheet prepared from an all sulphite furnish, having a bone-dry basis weight of 113.5 lbs. for a standard ream of 500 sheets, 24 by 36 inches, and an average thickness of approximately 11.0 thousandths of an inch, was impregnated with a dimethylol-urea mixture at a machine speed of 35 feet per minute. The impregnated sheet, after drying and curing, as in the previously described examples, had a bone-dry basis weight of 160.5 lbs. per standard ream, with a resin content on a bone-dry basis of 29.3%. The dimethylol-urea mixture used in the impregnation of this sheet was prepared by mixing 500 parts by weight of hot water (158° F.) with 100 parts by weight of urea, followed by the addition of 400 parts by weight of dimethylol-urea. The impregnation was effected without further dilution or the addition of further materials to the mixture.

Various resins of the phenol-aldehyde type can be used in the manufacture of masking sheet material in accordance with the present invention. These include resins derived from mono and polyhydric phenols and their derivations (cresols, cresylic acid derivatives, resorcinols) reacted with aldehydes, for example, formaldehyde (including formalin, para formaldehyde and hexamethylenetetramine), furfural, etc. Water soluble resins are to be preferred for economic reasons, although resins soluble in organic solvents can be used and will give equally good results. Resins soluble in organic solvents, in the absence of a solvent recovery system, are of doubtful economic practicability. Whichever type resins is used, it should be one which will give the necessary degree of cure within a reasonable interval of time. This means that a fast curing resin is preferred, and it will be under-

stood that accelerators can be added to the impregnating solution to increase the rate of cure. The phenol-aldehyde resins which have given the most satisfactory results are those which, although highly advanced, can be diluted with water or moderately alkaline solutions. In general, the final pH should be within the general range of from about 9.0 to 10.0.

Various urea-aldehyde resins can also be used in the manufacture of masking sheet material in accordance with the present invention. In the specific examples set forth above, the urea resins used were prepared by reacting formaldehyde directly with urea and by reacting the intermediate dimethylol-urea with additional urea. Unreacted resin mixtures suitable for impregnating the base sheet can also be prepared by the use of the intermediate monomethylol-urea and by other known formulation procedures.

Generally, however, in instances where the resin is prepared by mixing urea and formaldehyde, or equivalent intermediates, the unreacted resin mixture should contain materials equivalent to a ratio (on a molar basis) of 2 parts formaldehyde to from 1.0 to 1.4 parts urea. The impregnating mixture is desirably allowed to stand for from one to two hours before use, being maintained at a pH within the range of from about 6.5 to 8.5 during this period. Ammonia may be added for pH control, if required. The impregnation operation is desirably carried out at temperatures within the range of from 100° to 170° F., in order to assure most efficient impregnation of the sheet.

The amount of resin which is contained in the masking sheet is dependent upon several factors, some of which are somewhat conflicting in nature. The masking of defects can be obtained by the use of a sheet having extremely low or even zero resin content, however, such a sheet is of very doubtful utility, due to its poor physical characteristics. Up to a point, increase in the resin content improves the wear resistance and weather resistance of the sheet to a marked degree, while at the same time permitting the attainment of good masking characteristics. When phenol-aldehyde resins of the type described above are used for impregnating the sheet, the optimum resin content is within the range of from about 25 to 30 per cent, based on the total weight of the impregnated sheet as it comes from the oven 13. However, usable sheets having somewhat lower wear and weather resistant characteristics can be manufactured with resin contents as low as 5 per cent, and where cost of manufacture and handleability of the sheet are not too important, the resin content can be increased to as high as 35 per cent. The use of sheets having a resin content on a dry sheet basis of less than 10 per cent or greater than 35 per cent is not generally recommended.

The amount of uncured resin applied to the base sheet during the impregnating operation should be such, when urea-formaldehyde resins are employed, to produce a concentration of cured resin in the impregnated and dried sheet within the range of from 5 to 35 per cent by weight. The preferred resin content, as in the case of phenolic resin impregnation, is within the range of from about 25 to 30 per cent by weight, on a bone dry basis.

The density of the finished masking sheet as it comes from the oven 13, and prior to its application to the material with which it is used, is a particularly good index of the excellence of

the sheet. Generally stated, the masking sheet at this time, should have a density within the range of from about .60 to .95 gram per cubic centimeter, and sheets within this range will have satisfactory wet and dry abrasion resistance. In this connection, it is important to note that this density range is attained without the application of pressure during the curing operation.

It will be noted that the carrying out of the impregnation processes on apparatus of the type shown in Figure 1 causes the resin reaction to be completed and the resin to be formed within the cellulosic web of the base sheet. This is believed to be of some importance in accomplishing the objects of the invention, and especially increasing wet abrasion, by the procedures hereinafter set forth.

The drawings also illustrate apparatus for preparing a masking sheet by the addition of all or part of the resin-impregnation to the pulp prior to formation of the sheet, this apparatus being illustrated in Figure 2. The incorporation of all or part of the resin into the pulp has several distinct advantages. In the first place, such a method is inherently economical because the resin is incorporated into the sheet without the necessity of an additional step and the need for impregnating apparatus is eliminated. In the second place, the resin can be uniformly distributed in the pulp through the inherent operation of the beaters, which are normally employed in preparing the pulp for the papermaking operation, independently of the characteristics of the resulting sheet.

In the particular apparatus shown in Figure 2, a beater, which is employed in the usual manner, is illustrated generally at 31. During operation of the apparatus, it is intended that a beater addition resin which may be in liquid or comminuted solids form, and of either the soluble or insoluble type, shall be added to the pulp and other constituents of the paper furnish being processed in the beater. The beater 31 thoroughly mixes the resin with the pulp and inherently uniformly distributes the resin throughout the paper furnish.

After the pulp and resin are thoroughly mixed, the contents of the beater are delivered to a papermaking machine which may be the Fourdrinier type as shown at 33. The furnish is transferred from the beater 31 to the papermaking machine via the usual stock chest 35, and stock pump 37, which may be of the centrifugal type, as illustrated. From the stock pump 37, the pulp passes through a distributing flow box 39, machine screens 41, and flow box 43 in accordance with known practices. The masking sheet formed on the Fourdrinier wire 44 is conveyed through the usual press rolls 45 into a drier section 47. After passing through the dryer section, the sheet may be passed through calenders 49, and finally it is wound upon a take-up reel 51.

If a glue line is to be applied to one face of the resin-bearing sheet, the line may be applied after the sheet leaves the calenders 49. A suitable means for accomplishing the application of the glue line is shown in the illustrated apparatus, and includes a pan 52 for containing the adhesive in liquid form, a dip roll 53 and a pair of squeeze rolls 55 and 57. After passing through the adhesive applying means, the sheet is conducted through a drying chamber 59, which is operative to dry the adhesive on the sheet merely to a non-tacky condition. After application of

the glue line, the sheet may be taken up on the reel 51.

As in the case of the impregnated sheet resulting from the immersion process, the glue line adhesive can be applied as a completely separate operation, or it may be omitted entirely. When it is omitted, the adhesive for joining the masking sheet to the surface of the plywood, or other product with which the sheet is used, may be applied to the surface of the wood or a separate sheet or film of adhesive may be used intermediate the masking sheet and wood in accordance with well known practices. Generally, however, better masking characteristics are obtained when the glue line adhesive is applied to the sheet and dried to a non-tacky condition.

In the manufacture of resin-containing masking sheets in accordance with the invention, by processes whereby all or part of the resin impregnation is by beater addition procedures, the sheet may be made by the use of almost any of the known types of pulp. For example, I have found that unbleached kraft pulps, unbleached sulphite pulps, groundwood sulphite pulp mixtures, and semi-chemical pulps provide highly satisfactory results. While the results obtained are not dependent upon the kind of pulp, they are directly related to the pulp freeness. For obtaining most satisfactory abrasion resistance in the resulting masking sheet, lower pulp freenesses are desirable. However, if the pulp freeness is too low, the handleability of the resulting sheet may be impaired and the sheet will be more difficult to manufacture. Most satisfactory masking sheets are obtained when the freeness of the pulp lies in the range of from about 300 to 400 when measured by the Canadian freeness tester.

I have found that particularly good results can be obtained through the use of a pulp comprising a mixture of chemical pulp such as unbleached balsam sulphite and groundwood. In general, pulps of the desired freeness are obtained when the ratio of chemical pulp to groundwood is in the range of from about 50 to 75 parts of chemical pulp to from about 50 to 25 parts groundwood.

When comminuted insoluble resins are employed as beater addition resins, such as a water insoluble phenolic resin, further treatment of the pulp after resin addition is not required. However, when water soluble, alkaline soluble resins, or resin emulsions are used, it will generally be necessary to acidify or otherwise treat the pulp in order to deposit the resin upon the fibers comprising the pulp. If the pulp is not acidified, the resin may not bind satisfactorily to the pulp and, consequently, will drain from the pulp in the paper making operations. Accordingly, after a soluble resin or resin emulsion is added to the beater, the usual practice will be to reduce the pH of the pulp to a value from between about 4 and about 7 through the addition of an acidifying agent such as alum, sulfuric acid, mixtures of alum and sulphuric acid, mixtures of acetic and phosphoric acid, etc.

The addition of the acidifying agent causes the resin to come out of solution and deposit upon the cellulose fibers. In the case of some beater addition resins, this deposit constitutes a precipitation but, on the other hand, when other beater addition resins are employed, acidification results in the breaking of an emulsion or colloidal suspension causing the resin to coagulate upon the fibers.

Generally speaking, the lower the pH, the greater the percent of resin retention by the fibers. However, lower pH values interfere with the pulp processing and papermaking equipment. For best results, the pulp should be acidified to a pH in the range of 4.5 to 5.5.

Best masking qualities result when the basis weight of the sheet made by the use of a resin containing pulp is relatively high, in the range of from about 150 to 300 pounds per 500 ream of sheets 24 by 36 inches (bone dry basis). The thickness of the sheet should be in the range of from about 14 to 28 mils. However, in some instances, proper equipment may not be available for obtaining sheets of such high basis weight necessitating the manufacture of sheets having much lower basis weights. If such light-weight sheets are to be satisfactorily used for masking purposes, multiple layups will ordinarily be used, i. e. several of the sheets will be superposed upon one another, and the individual sheets may be held together by means of a light glue line attached to one side of the sheet or by means of a separate attachment sheet.

The resin content of the masking sheet impregnated by the beater addition process may vary between rather broad limits, depending upon the properties desired in the resulting sheet. Generally, the resin content of the sheet is directly proportional to the amount of abrasion resistance, water resistance, etc. However, if the resin content of the sheet is too high, handleability of the sheet is lowered and the masking sheet becomes too expensive. It has been found that optimum overall results are obtained when the final sheet contains between about 25 percent and about 30 percent resin, on a bone dry basis, as in the case of resin impregnated sheets prepared by the immersion process. However, a masking sheet satisfactory for many purposes is attainable with resin contents as low as about 10 per cent. The resin content should not be over about 35 per cent.

It will be understood, of course, that substantially greater amounts of resin will have to be added to the beater than is contained in the resulting sheet to compensate for inherent resin solubility, physical losses, etc. Investigations have shown that the losses may equal the amount of resin in the masking sheet and, accordingly, twice as much resin should be added to the beater than is present in the finished sheet.

The addition resins employed preferably constitute one or more of the relatively rapid curing resins. Such characteristics are important because the resins should advance to high degree of cure during manufacture of the sheet. In this connection, it should be noted that heretofore it has been considered undesirable to permit the resin in sheet material for laminating purposes, to advance in cure and such a result was avoided. Water soluble resins, or resins soluble in alkaline solutions are preferred, and there are various such phenol formaldehyde resins available commercially. Water dispersible resins in emulsion or dry powdered form may also be used.

It will be understood that urea formaldehyde and melamine resins having satisfactory characteristics may also be used. In the latter connection, investigations have shown that it is very difficult to obtain sheets containing more than about 6% resin (bone dry basis) when presently available beater addition resins of the urea and melamine type are employed. Accordingly, it may be necessary to incorporate one or more addi-

tional resins in such sheets by other impregnation procedures, as for example by the procedures hereinbefore described, to obtain a sufficient total resin content to provide a satisfactory masking sheet.

When resins are added to the beater in comminuted solids form, they tend to form globules in the resulting masking sheet and these globules are apparent in the masking sheet, thereby decreasing the marketability of the sheet. Therefore, the resin is preferably added to the pulp in liquid form and for this reason, water or alkaline soluble, or emulsion forming resins are employed.

In the manufacture of a satisfactory embodiment of the invention by the beater addition resin-impregnation procedure, a beater mixture consisting of 1170 pounds of unbleached hemlock sulphite pulp and 630 pounds of unbleached spruce groundwood was prepared. To this was added an alkaline solution of a phenol-aldehyde resin of the beater addition type, the solution comprising about 46% resin solids. Sufficient solution was added to provide 900 pounds of resin. The resin solution was allowed to mix with the pulp in the beater for approximately 10 minutes and an aqueous solution containing 25 per cent alum was added slowly to the mixture of pulp and resin until the pH of the beater contents was reduced to between 4.5 to 5.0. The stock had a freeness of 346 to 352 (Canadian freeness tester) after beating, and was delivered directly to a papermaking machine. Depending upon various operating speeds and machine conditions, the resulting masking sheet had a basis weight between 104 and 148 pounds per standard ream and a resin content of between 13 and 27 per cent. The density of the sheet varied between .63 and .72 gram per cubic centimeter and the thickness or caliper of the sheet varied between 19.3 and 27.3 one-thousandths of an inch.

As before noted, the resin is cured to a highly advanced state prior to taking up of the sheet on the reel 51. The masking sheet prepared by the use of addition resins thus includes a resin impregnation having a state of cure substantially the same as those resulting when the resin impregnation is incorporated into the sheet by other processes. Moreover, as before noted, sheets made by any of the processes are often times difficult to differentiate.

As has been indicated above, the masking sheet of the invention may be prepared by a combination of the above processes. Such a combination procedure is desirable when it is advantageous to incorporate two types of resins in the masking sheet, as for example, a phenol-aldehyde resin and a urea-aldehyde resin. This may be done by adding a beater addition resin to the pulp and then further impregnating the sheet made from the pulp with another type of resin by an immersion or other process. When this procedure is employed, the freeness of the pulp should be somewhat higher than before indicated to assure adequate and uniform impregnation of the second resin. However, the freeness should not be so great as to interfere with the abrasion and scuff resisting properties of the sheet. It appears that the proper freeness range for the usual multiple type impregnation should be from about 400 to 500, when measured by the Canadian freeness tester. It will be apparent that two or more types of resins may also be incorporated into a base sheet by carrying out the immersion impregnation procedure in suc-

cessive steps. It is desirable to advance the cure of the resin to a high degree before carrying out a second impregnation process but, under some circumstances, two or more types of resins may be applied to a base sheet in seriatim prior to curing.

As fully described in my aforementioned compending application Serial No. 116,810, where urea resins are employed in the treatment of the masking sheet, very remarkable improvement in the wet-abrasion resistance of the masking sheet material can be obtained by the introduction into the sheet, preferably before the impregnation of that sheet with resin, of small percentages of specific water soluble, inorganic acid salts of aluminum and ammonium. Specifically, these compounds are ammonium chloride, ammonium phosphate, ammonium sulfate, ammonium thiocyanate, aluminum chloride, and aluminum sulfate.

The amount of the aluminum or ammonium salts hereinafter referred to as the catalytic materials, which is present in the sheet during the resin curing operation, is quite critical if the desired increase in wet-abrasion resistance is to be obtained. It is also important that at least a part of the catalytic material, and preferably all of it be added to the base sheet prior to the resin-impregnating operation, this being particularly true when using aluminum sulfate which is the best of the several catalytic materials described. When a catalytic material of the type described above is used, the total amount of such material present in the sheet during the resin-curing operation should be within the range of from .4 to 1.5 per cent of the dry weight of the resin in the base sheet. The optimum amount of aluminum sulfate is within the range of from .4 to .8 per cent. A lesser amount of the catalytic material, or a greater amount, will substantially decrease the resulting beneficial effect and will result in a sheet of much less abrasion resistance.

Part of the catalytic material may be introduced into the base sheet as a component of the impregnating resin, although the resultant sheets are usually somewhat inferior in wet-abrasion resistance to the sheets obtained when all of the catalytic material is added to the base sheet prior to impregnation. Also it is possible to add all of the catalytic material to the impregnating resin, although this practice results in a much less wet-abrasion resistance sheet than is the case when at least part of the catalytic material is added to the base sheet.

The catalytic materials disclosed are all water soluble materials and may be conveniently introduced into the base sheet by passing the sheet through a water solution of the catalytic material. Generally, when using base sheets of the type described, the concentration of the catalytic salt in the water solution should be about half the concentration required in the base sheet. After passing the sheet through the solution of catalytic material, the sheet is desirably, but not necessarily, dried prior to the impregnation with resin.

The degree of curing which is accomplished when the resin-bearing sheet moves through the heated zones of the oven 13, or when the masking sheet is formed from resin containing pulp, is of the greatest importance in accomplishing the objects of the invention. In order that the completed sheet shall be capable of masking the various defects discussed above, the resin con-

tained in the sheet must be cured to such a degree that it will exhibit essentially non-flow characteristics when subjected to the pressures and temperatures normally employed in the manufacture of plywood, i. e. 150 to 300 pounds per square inch and from about 260° to 325° F. The cure must also be carried up to the point where the sheet is non-laminating at pressure in excess of 1000 pounds per square inch at a temperature in excess of 250° F. Unless curing is advanced to this extent, raised grain, patch outlines and splits will show through the cover or masking sheet, and the principal object of the invention, which is the production of a smooth, blemish free surface, will not be accomplished. However, the cure is desirably not carried to the point where the sheet would be non-laminating at pressures over 2000 pounds per square inch and temperatures over 350° F. If the cure is carried very much beyond this limit condition, the final sheet may be too brittle to handle in roll form and may be impractical or impossible to use. As used herein, the term "non-laminating" refers to the inability of the resin containing sheets to adhere to one another. Thus, if the resin containing sheets are placed in face to face relation and subjected to pressure and heat, as specified above, and do not adhere, the sheet is said to be non-laminating under those conditions.

The desired procedure of the invention requires that the cure be carried to the point where masking will be obtained, but not materially beyond that point. The determination of when the cure has proceeded to this optimum value, in the case of urea-aldehyde and melamine resins, can be readily accomplished by a mechanical testing procedure which will be described hereinafter in complete detail. When the resins employed are of the phenolaldehyde type, the state of cure may be ascertained by either this mechanical test or by a chemical test which will also be set forth hereinafter.

Cover or masking sheets manufactured as described above, or by equivalent processes, can be conveniently applied to the surfaces of plywood sheets in a conventional plywood hot press. Such a press is illustrated schematically in Figure 4, and as shown in that figure, includes a plurality of relatively movable, flat surfaced platens 55 disposed between top and bottom members 57 and 59, which also have flat platen surfaces thereon. Means are provided for heating the various platen surfaces, and when the press is in use, the plywood or other material is pressed between the platen surfaces, as illustrated at 61, under controlled conditions of temperature and pressure. As previously noted, pressures of the order of from 150 to 300 pounds per square inch with platen temperatures of the order of 260° to 325° F. are ordinarily employed in plywood hot presses. The masking sheet can be applied to a single veneer, or it can be applied to a complete plywood assembly of multiple cross grain veneer, and in either case, the masking sheet may be applied to either one or both surfaces. In the case of a plywood assembly, the cover or masking sheet is most conveniently joined to the other elements of the assembly during the manufacture of the plywood itself, but it can be attached to a completed sheet of plywood as a separate operation.

Regardless of the particular combination which is being effected, it is desirable to introduce the masking sheet into the press in such manner that it will be in contact with a caul plate

or with one of the heated surfaces of the platen during its attachment. In Figure 4, the masking sheets 63 are illustrated in direct contact with the platen surfaces. The advanced degree of cure which is effected during the manufacture of the sheet of the present invention makes it possible for that sheet to be placed in direct contact with one of the platen surfaces, or with a similarly surfaced plywood layer, and thereby makes possible the elimination of the caul plates which have heretofore been considered necessary when molding plastic sheet materials to the surface of plywood. When direct contact is made with the platen, its surface must be free from marring or defects.

The adhesives used for joining the masking sheet to the surface of the plywood or other material will depend somewhat on the particular procedure being followed. If the cover sheet is to be attached at the time the plywood is being manufactured, the glue line adhesive should consist of a thermosetting material having properties comparable to the adhesive used to bond together the several plies of the plywood. If, however, the cover sheet is bonded as a separate operation, the selection of the glue line adhesive will be controlled mainly by the ultimate use to which the material is to be put. In all instances where exterior grade plywood is being manufactured, the glue line adhesive must be of a water-proof type, such as a phenol-formaldehyde adhesive material. Wallboard or interior grade plywood permits the use of adhesives which are less water resistant, for example, urea-formaldehyde adhesives of the type which are not waterproof.

As previously pointed out, the degree to which the resin in the masking sheet is cured prior to the application of the sheet to the plywood or other surfaces is the most important part of the present invention, and considerable research work has been carried on in order to develop satisfactory tests for determining when the proper degree of cure has been reached. Probably the most satisfactory test developed to date for use with resin containing sheets is mechanical in nature and is somewhat a trial and error procedure.

In carrying out this test procedure in order to determine whether or not the impregnating resin has reached the proper degree of cure, a piece of the cured masking sheet material is subjected to the combined action of heat and pressure, while in contact with a metallic die plate having a pattern engraved in the surface thereof. When the die pattern is of proper outline and dimensions, the pattern, or a portion thereof, will show through the sheet at the conclusion of the test operation, if the degree of cure of the impregnating resin is less than the required minimum value. While various die shapes and arrangements will give the desired indication of masking ability, the die illustrated in Figures 6 and 7 of the drawing has proven particularly satisfactory for routine control tests. This die comprises a flat, square, steel plate 71, approximately 8 inches by 8 inches, having a thickness of $\frac{1}{2}$ inch. The surface of the plate 71 is provided with a plurality of concentric grooves 73, which define concentric, circular lands 75, having a width of approximately $\frac{5}{64}$ of an inch. The grooves are $\frac{3}{8}$ of an inch wide and $\frac{1}{64}$ inch deep, and the die plate 71 includes twenty-one grooves and twenty lands. The total area of the die which contacts the sheet during the test is approximately 43 square inches.

During the test, a test section 77 of the cured masking sheet is placed on a flat, rigid-backing plate 79, which may be a steel plate, and the die plate 71 is pressed into this sheet section with a uniform surface pressure of approximately 200 pounds per square inch over the entire area of the die, the total pressure thus applied being 12,800 pounds. The die plate 71, the backing plate 79, and the test section 77 are heated to a temperature of about 300° F. during the test, and the test section is held between the die and backing plates for a period of the order of from six to eight minutes, these figures applying for phenol and urea-formaldehyde resins of the type described above. If the resin contained in the masking sheet has been cured to an extent where the die marks are not visible through the sheet when observed from the side away from the die surface, after the test operation described, it is safe to assume that the curing has reached the required minimum amount. Desirably, the cure should not be continued beyond the point where proper masking is obtained, because further curing may result in undesired embrittlement of the sheet without improvement in the masking characteristics.

The test, as described in the foregoing, is capable of considerable variation and modification. Basically, the test establishes that the resin which is contained in the masking sheet has been cured to a point where it will exhibit essentially non-flowing characteristics when subjected to the pressures and temperatures normally used in the manufacture of hot-pressed plywood. For example, the test die might include a single land or a simple, single line outline of proper dimensions.

It will also be apparent that the land width might be changed by using pressures and temperatures substantially different from the pressures and temperatures used in the manufacture of hot-pressed plywood. Since, as previously stated, the purpose of the test is merely the establishment of the fact that the resin in the masking sheet has been cured to essentially non-flowing conditions under the pressures and temperatures to which it will be exposed during the subsequent plywood manufacturing operation, any test which is capable of correlation to these conditions may be used.

When the resin-containing sheet includes phenol-aldehyde resins, a chemical test may be employed for ascertaining the degree of cure. In the practice of this method for determining when the resin in the masking sheet has reached a sufficient degree of cure, use is made of the fact that the amount of phenol-aldehyde resin which is extractable from the cured masking sheet by the use of hot acetone (which has unusually high resin solvation power and which is capable of dissolving resins which have advanced to high degrees of cure), is indicative of the degree of cure of that resin. The preferred extraction procedure is set forth in publication D491-41 of the American Society for Testing Materials, this publication being entitled "Acetone extraction of phenolic molded or laminated products."

The above identified ASTM procedure for determining resin extractability includes the steps of taking a known weight of a characteristic sample of the cured sheet material which has been finely comminuted or macerated, and then placing the weighed sample in a Soxhlet apparatus, where it is extracted with hot acetone for a period of four hours. Following this, the acetone

is evaporated under controlled conditions, and the residue remaining constitutes the extractable portion. Then by simple mathematics, the percentage of extractable resin can be calculated.

Similarly, extended tests and investigations have shown that satisfactory masking will result provided that the maximum quantity of phenolic-like resin material which is extractable from the cured masking sheet, as described, does not exceed a percentage figure which is equal to four plus the change in cure, expressed as a whole number equal to the percentage change in extractability during the one minute interval preceding the arrival at 4 per cent extractability. (It should be noted that the per cent of extractable resin in this procedure is based on the total weight of the sheet and not on the resin content alone.) Stated in another way, a resin sheet impregnated with a phenolic resin in the manner described will be satisfactory for masking purposes if, upon additional curing of the sheet for one minute at the temperatures and pressures employed in the manufacture of the commercial plywood products, it contains four or less percent of extractable resin.

In determining the percentage change values, it is most convenient to plot a curve of the percent extractable resin against the time of cure, and illustrative curves of this type are illustrated in Figure 8. Data for curves of this type is obtained by selecting a series of samples of the base sheet containing the resin which is to be evaluated, and curing the samples to various degrees by placing the sample sheets in an oven for various intervals of time, the oven being maintained at the temperature at which the sheet is normally cured. Following the curing operation, the per cent of extractable resin contained in each of the samples is determined according to the ASTM procedure described above. A plot or graph may then be obtained, illustrating the variation in the per cent of extractable resin against curing time as illustrated in Figure 8.

To determine the minimum permissible degree of cure from one of these curves, a line is drawn parallel to the abscissa at the ordinate value equal to 4 per cent extractable resin. Then, by extrapolation as shown by the dotted lines in Figure 8, the amount of cure obtainable in the minute preceding the arrival at 4 per cent extractable resin can be accurately determined. This value, added to the empirically determined constant 4, as described above, will give the maximum percentage of extractable resin which can be tolerated in the masking sheet. It will be found that the permissible maximum amount of extractable resin will vary, depending upon the particular resin or resin mixtures used for impregnation. For example, a fast curing resin or resin mixture, as illustrated in the curve numbered I in Figure 8, will give good masking with a maximum extractable resin percentage of 12.4 per cent, whereas a slow curing resin or resin mixture, as illustrated in the curve numbered III, requires that the cure be continued to a point where the maximum extractable resin is no greater than 4.9 per cent. If the samples are cured at the same temperature as that used in the curing oven for the masking sheet, the proper curing time can be determined directly therefrom. Otherwise tests may be required.

When the masking sheet is made from resin containing pulp, it has been found more desirable to employ a mixture of 5 parts hydrochloric acid and 95 parts acetone for extraction purposes in

the above chemical test. However, if such a mixture is used for extraction purposes then the standard A. S. T. M. extraction procedure described above can not be used because of the difference in vapor pressures of the components of the solution. The extraction procedure used in such instances then is as follows. A weighed sample of the material is suspended in a hot mixture consisting of 95 parts acetone and 5 parts concentrated hydrochloric acid and occasionally stirred. After about 10 minutes the sample is removed from the acetone hydrochloric acid mixture and suspended in a hot, fresh solution of acetone hydrochloric acid comprising the same proportions as in the first extraction step. After a second ten minute interval with occasional stirring, the extraction step is repeated a third time. The sample is then removed from the mixture, air dried to remove excess acetone, and dried in 105° C. oven for 10 minutes. The weight of the dried sample is then determined. From this weight together with the initial weight of the sample the per cent of acetone extractable material can readily be determined by simple calculation.

In order to obtain increased wet strength in the base sheet used in the manufacture of masking sheets in accordance with the invention, it will sometimes be found desirable to add to that sheet a wet-strength resin, or other material, in accordance with known practices in the paper-making art. Some of these resins are of the beater addition type, although others are added to the sheet by impregnating operations. Insofar as the production of the masking sheets of the present invention are concerned, the presence or absence of these wet-strength producing additives in the percentages normally employed ($\frac{1}{2}$ to 3% of the dry weight of the cellulose), has little effect. Also, it makes no difference whether the additive is of a resinous or other nature. Similarly, the base sheet may contain pigments or printing, if decorative surfacings are to be produced.

The cover or masking sheets described in the foregoing make possible the attainment of a very smooth, easily finished surface on plywood and similar materials. The surface provided may be either light or dark in color; it may include decorative effects; and it will receive paint and enamel finishes particularly well. Of even greater importance, from a commercial standpoint, the masking sheets of the invention effectively mask plug patches, grain raising and checking, and can be manufactured and applied to the plywood or other sheet materials with which they are used at relatively low cost.

Various of the features of the invention are set forth in the following claims.

I claim:

1. The improvement in the process of manufacturing fibrous sheet covered plywood the face of which plywood adjacent the fibrous sheet contains surface defects, which comprises the steps of impregnating a paper sheet having a basis weight, when dry, within the range of from 110 to 210 pounds for 500 sheets 24 by 36 inches, and a density within the range of from .55 to .80 gram per cubic centimeter, with a thermosetting aldehyde resin to provide a resin content in said sheet, after drying, within the range of from about 5 to 35% of the weight of the dry impregnated sheet; drying the resin-containing sheet; heating said dry, resin-containing sheet to cure the resin contained therein to such an extent

that when a section of the cured sheet is pressed between a flat, metallic, backing plate and a flat, metallic, die plate, both approximately 8 inches by 8 inches square, said die plate having over the greater portion of its surface concentric lands $\frac{5}{16}$ of an inch in width, spaced apart by concentric grooves $\frac{3}{8}$ of an inch in width, with a force of about 12,800 pounds, uniformly distributed over the plate, the sheet being heated during the pressing operation to a temperature of about 300° F. while maintained under pressure for a period of six to eight minutes, said sheet is free of visible marks corresponding to the die pattern on the side thereof opposite to the side in contact with the die surface; placing at least one ply of said cured sheet over the exposed face of one of the outer veneers of a plywood assembly which face contains surface defects, when that assembly is placed in a plywood press; providing a glue line adhesive intermediate the resin-containing sheet and the adjacent veneer; and finally subjecting said assembly, in said press, to pressure within the range of from about 150 to 300 pounds per square inch and a temperature within the range of from about 260 to 325° F. to effect the joining of the plies of the plywood assembly and the attachment of the cured resin-containing sheet to the surface veneer solely by the adhesive action of said glue line.

2. The improvement in the process of manufacturing fibrous sheet covered plywood the face of which plywood adjacent the fibrous sheet contains surface defects, which comprises the steps of impregnating a paper sheet having a basis weight, when dry, within the range of from about 110 to 210 pounds for 500 sheets 24 by 36 inches, and a density within the range of from .55 to .80 gram per cubic centimeter, with a thermosetting aldehyde resin to provide a resin content in said sheet, after drying, within the range of from about 5 to 35% of the weight of the dry impregnated sheet; drying the resin-containing sheet, said impregnated sheet having a basis weight when dry within the range of from about .60 to .95 gram per cubic centimeter; heating said dry, resin-containing sheet to cure the resin contained therein to such an extent that when a section of the cured sheet is pressed between a flat, metallic backing plate and a flat, metallic die plate, both approximately 8 inches by 8 inches square, said die plate having over the greater portion of its surface concentric lands $\frac{5}{16}$ of an inch in width, spaced apart by concentric grooves $\frac{3}{8}$ of an inch in width, with a force of about 12,800 pounds, uniformly distributed over the plate, the sheet being heated during the pressing operation to a temperature of about 300° F. while maintained under pressure for a period of six to eight minutes, said sheet is free of visible marks corresponding to the die pattern on the side thereof opposite to the side in contact with the die surface; placing at least one ply of said cured sheet over the exposed face of one of the outer veneers of a plywood assembly which face contains surface defects, when that assembly is placed in a plywood press; providing a glue line adhesive intermediate the resin-containing sheet and the adjacent veneer; and finally subjecting said assembly, in said press, to pressure within the range of from about 150 to 300 pounds per square inch and a temperature within the range of from about 260 to 325° F. to effect the joining of the plies of the plywood assembly and the attachment of the cured resin-containing

sheet to the surface veneer solely by the adhesive action of said glue line.

3. The improvement in the process of manufacturing fibrous sheet covered plywood the face of which plywood adjacent the fibrous sheet contains surface defects which comprises placing at least one ply of a masking sheet having high wet and abrasion resistance over the exposed face of one of the outer veneers of a plywood assembly which face contains surface defects when that assembly is placed in a plywood press, said masking sheet consisting of a cellulose fiber base sheet having an unimpregnated basis weight when dry within the range of from about 110 to 210 pounds for 500 sheets 24 by 36 inches and an unimpregnated density within the range of from about .55 to .80 gram per cubic centimeter, and containing from about 5 to 35%, based on the finished total weight of the dry, resin-containing sheet, of a thermosetting aldehyde resin, said resin being cured to such an extent that when a section of a cured sheet is pressed between a flat, metallic, backing plate and a flat, metallic, die plate, both approximately 8 inches by 8 inches square, said die plate having over the greater portion of its surface concentric lands $\frac{5}{16}$ of an inch in width, spaced apart by concentric grooves $\frac{3}{8}$ of an inch in width, with a force of about 12,800 pounds, uniformly distributed over the plate, the sheet being heated during the pressing operation to a temperature of about 300° F. and being maintained under pressure for a period of six to eight minutes, said sheet is free of visible marks corresponding to the die pattern on the side thereof opposite to the side in contact with the die surface, providing a glue line adhesive intermediate the cured resin-containing masking sheet and the adjacent veneer; and finally subjecting said assembly, in said press, to pressure within the range of from about 150 to 300 pounds per square inch and a temperature within the range of from about 260° to 325° F. to effect the joining of the plies of the plywood assembly and the attachment of the cured resin-containing masking sheet to the surface veneer solely by the adhesive action of said glue line.

4. The improvement in the process of manufacturing fibrous sheet covered plywood the face of which plywood adjacent the fibrous sheet contains surface defects which comprises placing at least one ply of a masking sheet having high wet and abrasion resistance over the exposed face of one of the outer veneers of a plywood assembly which face contains surface defects when that assembly is placed in a plywood press, said masking sheet consisting of a cellulose fiber base sheet which is impregnated with a thermosetting aldehyde resin, said base sheet having an unimpregnated basis weight, when dry, within the range of from about 110 to 210 pounds for 500 sheets 24 by 36 inches, and an unimpregnated density within the range of from about .55 to .80 gram per cubic centimeter, said impregnated sheet containing from about 5 to 35%, based on the finished total weight of the dry impregnated sheet, of the impregnating resin, said impregnated sheet having a basis weight when dry within the range of from about .60 to .95 gram per cubic centimeter, and said resin being cured to such an extent that when a section of the cured sheet is pressed between a flat, metallic, backing plate and a flat, metallic, die plate, both approximately 8 inches by 8 inches square, said die plate having over the greater portion of its surface concentric

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lands $\frac{5}{64}$ of an inch in width, spaced apart by concentric grooves $\frac{3}{32}$ of an inch in width, with a force of about 12,800 pounds uniformly distributed over the plate, the sheet being heated during the pressing operation to a temperature of about 300° F. and being maintained under pressure for a period of six to eight minutes, said sheet is free of visible marks corresponding to the die pattern on the side thereof opposite to the side in contact with the die surface, providing a glue line adhesive intermediate the cured resin-containing masking sheet and the adjacent veneer; and finally subjecting said assembly, in said press, to pressure within the range of from about 150 to 300 pounds per square inch and a temperature within the range of from about 260° to 325° F. to effect the joining of the plies of the plywood assembly and the attach-

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ment of the cured resin-containing masking sheet to the surface veneer solely by the adhesive action of said glue line.

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