

Feb. 14, 1950

R. J. AUCHTER
PROCESS OF MANUFACTURING A FIBROUS
SHEET COVERED PLYWOOD
Filed June 5, 1944

2,497,712

Fig. 1

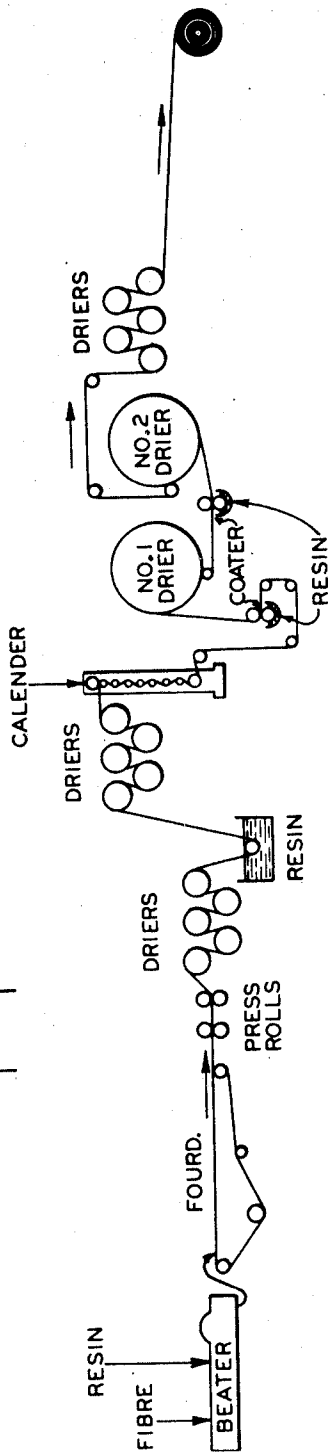


Fig. 2

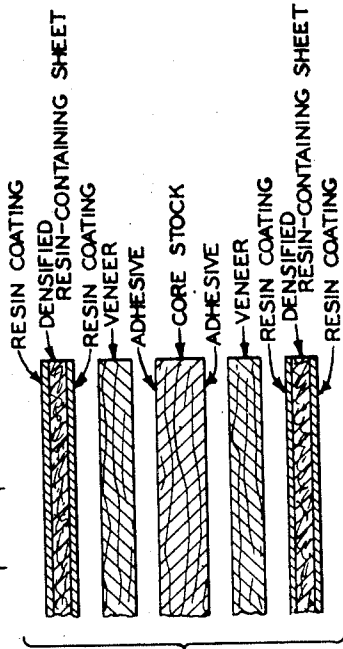
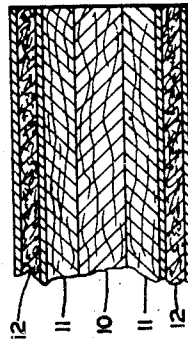


Fig. 3



Inventor:
Richard J. Auchter,
By *Loane, Pond & Anderson,*
Attorneys.

UNITED STATES PATENT OFFICE

2,497,712

PROCESS OF MANUFACTURING A FIBROUS SHEET COVERED PLYWOOD

Richard J. Auchter, Appleton, Wis., assignor to
Paper Patents Company, Neenah, Wis., a corporation of Wisconsin

Application June 5, 1944, Serial No. 538,767

2 Claims. (Cl. 154—132)

1

The invention relates to improvements in the manufacture of paper webs of the character which are designated by the word resinated, meaning paper webs of that type which, on their surface or through the body thereof are charged or loaded with any type of resin which, by heat or pressure, or both, can be converted into a condition in which improved strength or other characteristics will be imparted to the paper web.

It has been found desirable, in the use of resinated papers of the character described, to have a greater concentration of resin on the outer surface of the sheet than throughout the body of the sheet. The outer resin imparts resistance to abrasion, but, if the percentage of resin is too large throughout the body of the sheet, not only is the sheet expensive, but the cushioning effect is impaired. On the other hand, it is necessary that the sheet should have some power or strength to prevent delamination, i. e. splitting of the sheet into two separate laminations.

The object of the present invention is to provide a sheet the outer surface of which will have a sufficient concentration of resin to impart the necessary abrasion resistance while at the same time the body of the sheet has sufficient cohesion to prevent delamination while having the necessary cushioning effect, and further to obtain all of said desirable properties at minimum cost.

According to the preferred method of practicing the invention, the sheet of paper, which may be made on a Fourdrinier wire or other conventional type of paper machine, is produced in the usual manner, except that, at some stage in the paper-making process, before the paper has been fully dried, a supply of resin is introduced throughout the body of the paper. This resin may be introduced by employing a soluble resin and dipping or immersing the web into the resin solution according to any usual tub sizing method, preferably before the web has reached the final stage of dryness, or a supply of water-insoluble resin may be introduced into the furnish before the formation of the sheet on the wire has been finally completed. In the latter case, the water-insoluble resin may be introduced into the beater or into the stock or web at a later stage in the paper-making process.

According to the preferred procedure, the web, after it has been charged or loaded with the required amount of resin distributed through the body of the sheet as above described, is then subjected to a calendering or densifying operation. The purpose of this calendering operation is to press the fibers of the sheet to such an extent

2

that, when a resin solution is subsequently applied to the exterior surfaces of the sheet, such resin solution will not penetrate into the sheet to any material depth, but will remain substantially at the surface.

After the densifying or calendering operation, the sheet is then coated on both sides with a resin solution or suspension of the proper consistency, and the sheet is then subjected to a suitable drying operation to drive off any solvent and to reduce the water content to standard.

In the drawings,

Figure 1 illustrates in diagrammatic form a type of equipment for practicing the invention according to a selected preferred method;

Figure 2 is an enlarged, fragmentary, cross-sectional view showing the constituent parts of a plywood panel assembly embodying a resin-containing web in accordance with the present invention; and

Figure 3 is a fragmentary view similar to Figure 2, showing a completed plywood panel.

Specific example

The base furnish of the sheet preferably is principally made up of long fibered wood pulp produced by any of the chemical pulp processes, for example, white sulfite pulp, and the remainder of the furnish can be of a good grade of short fibered wood pulp or groundwood, preferably not more than 25% of the latter. The object should be to produce a base sheet which is quite "free" in character so as to permit uniform and thorough penetration of any resin solution which is employed to load the body of the sheet with resin in the first stage of the process.

I have shown two ways of incorporating the resin in the body of the sheet. If a water insoluble resin is available, it is possible to add the same to the beater in finely powdered form. This has some advantages in that it is not necessary to remove the solvent at a later stage in the process. After the stock has been properly beaten, it is delivered to the Fourdrinier wire of a paper machine from which the completed web passes through the usual press rolls and dryers where it is dried down to a water content of about 5% to 20%. The paper is then passed through a tank or tub containing a water solution of a water-soluble resin, preferably of the phenolic type. The sheet then goes through another set of dryers where it is dried down to a water content of about 10% to 20%.

The paper is then conducted through a super-calender stack where it makes eight passes under

a pressure of from 2,000 to 4,000 lbs. per linear inch. The calendering operation serves to compact or densify the sheet, reducing its thickness to about 80% of its original caliper.

From the calender stack the sheet passes through a coating mechanism of the general type disclosed in the Germanson & Kranhold Patent No. 1,918,095 where it receives a surface coating of a solution of a soluble resin, preferably an aqueous solution of a water soluble resin of the same type which has been used in the prior stage of the process for impregnating the body of the sheet. It is understood that the type of resin and the consistency thereof is of such character that the thickness of coating applied by the coater will serve the desired purpose.

The sheet coated on the upper side is then conducted to a large drying cylinder where most of the solvent is removed, and then it is conducted through another coater similar to the first coater where the lower side received a similar coating of similar resin.

After leaving this second coater, the sheet travels around the circumference of a second large drying cylinder, and from there it passes to a final set of dryers which reduce the sheet to its final condition of dryness. The finished dry sheet is then rolled up and is ready for use.

In practicing the process by the use of the above equipment, the preliminary resinating of the sheet prior to the application of the surface coatings may be effected by introducing resin into the beater, the immersion step being omitted, or, in some cases, all of this preliminary resinating can be effected by the immersion step, no resin being added in the beater.

The amount of resin which is distributed within the body of the sheet by the preliminary resinating treatment, in whatever manner performed, may be from 25% to 75% of the total resin carried by the finished sheet, so that, on the finished sheet from 25% to 75% of the resin will be found to be concentrated at the surface where it will be most effective. However, it will be understood that the amount of resin contained in the body of the sheet may be varied greatly according to the thickness and character of the sheet, it being understood that there must be sufficient resin in the sheet so that the sheet will not be subject to the danger of delamination within itself.

The calendering operation, although of the same general character as is used in the calendering of book paper, is not so drastic an operation as would result in the making of a hydrated sheet. Furthermore, with the present process, it will be found more economical and efficient to make the sheet of a higher basis weight than can be hydrated by the usual commercial methods. For example, this process can be successfully employed in the case of sheets having a basis weight of from 60 to 100 lbs. per ream of 3,000 sq. ft., or the basis weight may be still further increased to as high as 200 lbs. per ream.

A relatively thick sheet, although slower to make on the machine, has some advantages over relatively thinner sheets. For example, when this material is to be used for covering such materials as wooden plywood or gypsum board, pressed wood or similar panels, it is not usually possible to obtain the desired thickness of surface sheet by the use of a single ply of this resinated paper, and it is often necessary to use from three to ten plies in order to obtain the required thickness of covering.

It will be obvious that, if a sheet of this ma-

terial is thick enough of and by itself so that it can be used as a single ply, in that case all of the resin between the outside surface coatings will be available to hold the fibers of the sheet together, whereas, if the sheet is built up of four different plies, it will be necessary to provide sufficient resin between adjacent surfaces of additional plies in order to secure the plies together. In other words, in a sheet built up of a plurality of plies, the resin will not be properly distributed through the body of the multi-ply structure. Hence, in order to use the present invention to the best advantage, it will be found advantageous to use sheets as thick as are practical to make with available processes and equipment.

As to the weight of the resin which is required, it will be understood that, according to the old method in which the resin is distributed uniformly through the body of the sheet, it is found necessary to have about as much resin as the basis weight, so that the weight of resin will represent about 50% of the weight of the sheet. According to the present invention, in order to obtain similar or even better results than can be obtained with the old methods considerably less resin is required, in some cases as little as $\frac{1}{2}$ of the basis weight. The amount of resin contained in the surface coatings may be about $\frac{1}{2}$ or $\frac{1}{3}$ of the amount which is used to impregnate the body of the sheet.

Although, for certain purposes, a thermoplastic resin may be employed, the present invention is of particular value when using resins of the thermosetting type which become polymerized when subjected to heat or to heat and pressure both. It is, of course, advisable to use considerable pressure in order to obtain the desired surface characteristics and to obtain proper bonding. However, it is not necessary to employ as heavy pressures as must be employed in the case of multi-ply sheets in which the resin is distributed uniformly through the body of the sheet. This lower pressure possesses certain obvious advantages.

In the use of the resin-containing sheets of the present invention in the surfacing of plywood, it will usually be found most convenient to effect the attachment of the sheets to the plywood panel during its manufacture. A suitable assembly of elements for manufacturing a surfaced-plywood panel is illustrated in Figure 2. Conveniently, a resin containing and resin coated sheet in accordance with the invention will be placed on an assembly table, following which the other elements of the panel will be superposed thereon, in order. Suitable adhesive will, of course, be included between the core stock and the veneers, either a dry film or a surfacing coating being utilized as is conventional in the plywood industry.

The final element in the lay-up comprises the surfacing sheet for the top surface of the panel, and after the assembly operation, the complete lay-up unit is placed in a plywood press, as in the manufacture of non-surfaced plywood. During the pressing operation, the heat and pressure transmitted to the elements of the panel effects the adhesion of the veneers to the core stock, and the attachment of the surfacing sheets to the underlying veneers to provide an integral structure. The resin layer on the inner surface of each of the surfacing sheets is available for adhering the surface sheets to the associated underlying veneer, and the resin layer on the outer

5

surface of the surfacing sheets provides the desired resin surface on the finished panel.

The resultant panel is illustrated in the fragmentary view Figure 3, in which view the core stock is illustrated at 10, the two veneer layers at 11, and the surfacing layers at 12. It will be understood that the surfacing sheets of the invention may be applied to a single veneer, and that the resulting surfaced veneer can be used in the manufacture of surfaced plywood by the various known methods.

I claim:

1. The improvement in the process of manufacturing a fibrous sheet covered plywood, which comprises the steps of first distributing throughout the body of a paper web having a basis weight within the range of from about 60 to 200 pounds per 3000 square feet condensable resin in an amount sufficient to produce a resin content of from 20 to 50 per cent of the weight of the sheet when fully dried, drying the resin-containing web to a moisture content of from about 10 to 20 per cent, then calendering the dried, resin-containing web to substantially reduce the thickness thereof, applying to both faces of the web a surface coating of condensable resin, drying the coated web to eliminate volatile material from said web and said coating, then placing a layer of at least one ply of said web over one face of a veneer which is to become an outer ply of the finished plywood panel and subjecting said web and veneer to sufficient heat and pressure to condense said resin, thereby to provide said veneer with an outer, protective, cover sheet of composite resin and fiber, the outer face of said cover sheet being composed substantially wholly of resin, and the inner face of said cover sheet being bonded to the face of the adjacent veneer by resin obtained from said web.

2. The improvement in the process of manufacturing a fibrous sheet covered plywood, which comprises the steps of distributing throughout the body of a paper web having a basis weight within the range of from about 60 to 200 pounds per 3000 square feet condensable resin in an amount sufficient to produce a resin content of from 20 to 50 per cent of the weight of the sheet when fully dried, drying the resin-containing web

6

to a moisture content of from about 10 to 20 per cent, then calendering the dried, resin-containing web to reduce the thickness thereof at least to about 60 per cent of its uncalendered caliper, coating both faces of said web with a surface coating of a condensable resin, drying the coated web to eliminate any volatile material in said coating and to provide a web having a materially greater concentration of resin per unit of volume of the web at the surfaces of the web than through the body thereof, then placing a fibrous layer which comprises at least one ply of said web over one face of a veneer which is to become an outer ply of the panel, and finally subjecting said web and veneer to sufficient heat and pressure to condense said resin, thereby to provide said veneer with an outer, protective, cover sheet of composite resin and fiber, the outer face of said cover sheet being composed substantially wholly of resin, and the inner face of said cover sheet being bonded to the underlying face of the adjacent veneer layer by resin obtained from said web layer.

RICHARD J. AUCHTER.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,160,365	Baekeland	Nov. 16, 1915
1,904,087	Schacht	Apr. 18, 1933
1,937,317	Codwise	Nov. 28, 1933
1,986,961	Dodge	Jan. 8, 1935
2,077,015	Schacht	Apr. 13, 1937
2,343,740	Birmingham	Mar. 7, 1944
2,370,090	Thies	Feb. 20, 1945
2,378,113	Van De Car	June 12, 1945
2,391,489	Stamm	Dec. 25, 1945
2,463,856	Dickerman	Mar. 8, 1949

OTHER REFERENCES

The Manufacture of Pulp and Paper, vol. 5, 3rd ed., Section 1, page 214. Published 1939 by McGraw-Hill Book Co., New York, N. Y. (Copy in Division 56.)