April 27, 1954 H. HAMBURG 2,676,884

MANUFACTURE OF ARTICLES SUCH AS BOARDS AND SHEETS FROM FIBROUS VEGETABLE MATERIALS

Filed Dec. 22, 1948 2 Sheets-Sheet 1

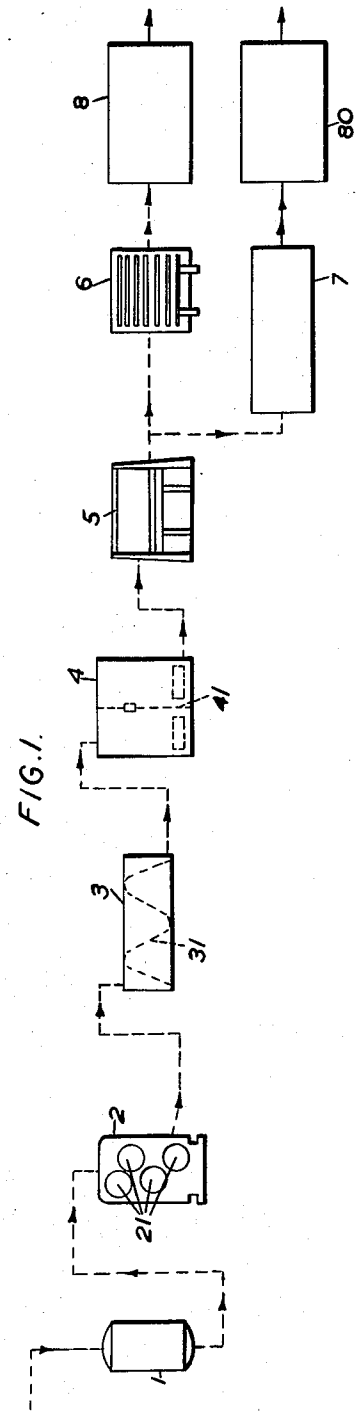


FIG. 1.

Inventor
HERMAN HAMBURG

By

Attorney

April 27, 1954 H. HAMBURG 2,676,884

MANUFACTURE OF ARTICLES SUCH AS BOARDS AND SHEETS FROM FIBROUS VEGETABLE MATERIALS

Filed Dec. 22, 1948 2 Sheets-Sheet 2

FIG.2

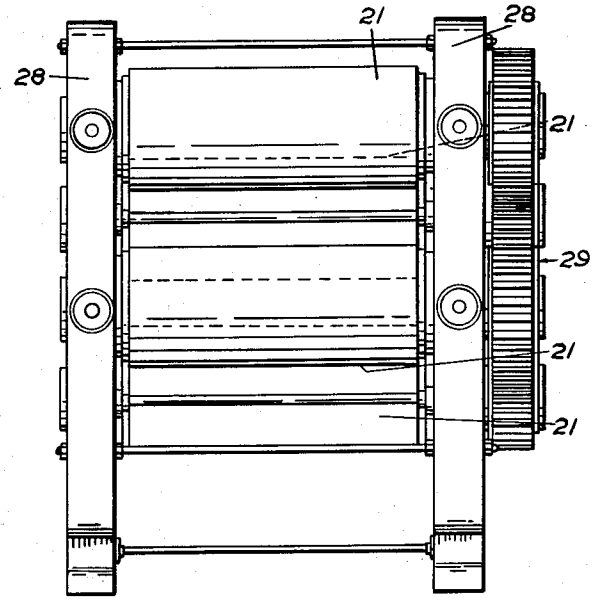
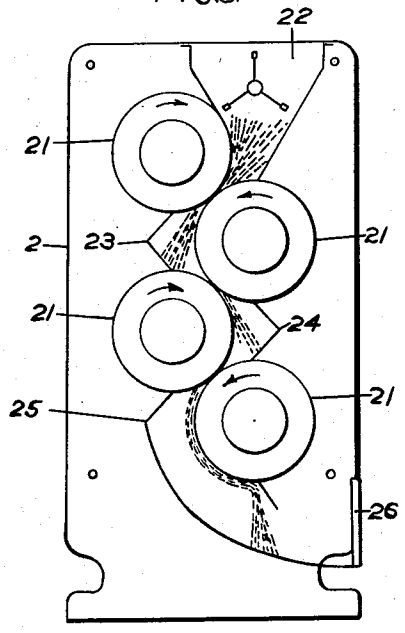


FIG.3



Inventor
HERMAN HAMBURG
By
Attorney

Patented Apr. 27, 1954 2,676,884

UNITED STATES PATENT OFFICE

2,676,884

MANUFACTURE OF ARTICLES SUCH AS BOARDS AND SHEETS FROM FIBROUS VEGETABLE MATERIALS

Herman Hamburg, Richmond, England, assignor to Syntics Limited, London, England, a British company

Application December 22, 1948, Serial No. 66,784

Claims priority, application Great Britain September 19, 1946

3 Claims. (Cl. 92—21)

1

This is a continuation-in-part of patent application Serial No. 772,903, filed September 8, 1947, now abandoned, and relating to "The Manufacture of Boards, Sheets and Similar Articles from Fibrous Organic Materials."

The present invention relates to the manufacture of articles such as boards and sheets resembling hardwood from vegetable fibrous materials, and especially from waste fibrous materials such as sawdust, woodshavings, straw, and the like.

It has already been proposed to make boards and sheets from vegetable fibrous waste material by mixing the waste material with a sufficient quantity of resinous binders and shaping the mixture under heat and pressure into boards or sheets. Such boards and sheets, however, are liable to be affected by atmospheric conditions unless a high proportion of synthetic resin, which is expensive, has been incorporated therein. Moreover, it is difficult to shape the mixture into homogeneous boards or sheets of uniform density and strength.

It is an object of the invention to avoid these drawbacks.

It is another object of the invention to provide hard wearing homogeneous boards, sheets and other articles of substantially grainless structure and great mechanical strength, which are water-repellent and moisture resistant, and which have the characteristics of a synthetic hardwood.

It is a further object of the invention to enable vegetable fibrous waste materials to be utilised for manufacturing boards, sheets and other articles, without grading the waste materials in any way or drying them prior to the manufacturing process. For example, hardwood sawdust may be mixed with softwood sawdust, and the water content of the mixture is immaterial.

It is still another object of the invention, in the manufacture of boards, sheets and other articles, to treat vegetable fibrous waste material in such a manner that it will not require the addition of any resin or other binding agent to impart the desired mechanical strength and moisture resistance to the final product.

It is a particular advantage of this invention that sawdust, straw or the like material having short fibres may be used without impairing the desired qualities, such as strength, homogeneity and substantially grainless structure.

In accordance with the present invention, boards, sheets and other articles are made from a predigested pulp-like mass of vegetable fibrous raw material by impregnating the vegetable

2

fibrous raw material, after the water content of the predigested mass has been reduced by at least one-third, with one or more inorganic salts in solution which will allow the subsequent precipitation of insoluble inorganic compounds within the mass by the subsequent addition of suitable chemical reagents; from the suspension or slurry obtained after such precipitation has been effected, boards or other desired articles are formed in known manner, and the articles obtained are subjected to an additional heat treatment. It will be noted that the material is in a comparatively dry state while it is impregnated with the inorganic salt or salts.

It has been found that the finely divided precipitate of an insoluble inorganic compound or compounds confers, even in comparatively small quantities by weight (for example 3 to 4 per cent in the final article), valuable properties upon the fibrous suspension from which the boards or other articles are subsequently formed.

In carrying out the process, the predigestion of the vegetable fibrous raw material may be effected either by adding weak alkaline solutions to the raw material or by subjecting it merely to a treatment with steam at an elevated pressure. The pressure may, for example, be between 20 and 50 lbs. per square inch. Thereby a fibrous mass is obtained which is then subjected to heavy mechanical pressure and subsequently impregnated with a solution of the inorganic salt or salts preparatory to the precipitation. Alternatively, the digesting and impregnating steps of the process may be combined by pre-digesting the raw material with a solution which also will allow the subsequent precipitation.

To make the invention clearly understood, reference will now be made to the accompanying drawings, which are given by way of example only and in which:

Fig. 1 diagrammatically illustrates the general lay-out of an arrangement for carrying out a preferred method of the invention;

Fig. 2 is a somewhat diagrammatic front view; and

Fig. 3 is a somewhat diagrammatic section along the line III—III of Fig. 2 of a detail of the arrangement of Fig. 1.

Referring first to Fig. 1, in the preferred method illustrated vegetable fibrous waste material is fed to a vessel 1 and is pre-digested therein for about one to four hours with a weak solution (0.5 to 5%) of caustic alkali or calcium hydroxide at a temperature of about 100 to 140° C. The fibrous mass so obtained is washed and trans-

ferred to a pressure device 2, where it is subjected to heavy mechanical pressure between pairs of suitable rolls 21 of cast iron or stone. The pressure to which the material is subjected may vary according to the type of the raw material and may range from 50 to 1000 lbs. per linear inch in the nip between the rolls 21. As more clearly shown in Figs. 2 and 3, the pressure device 2 comprises 4 rollers 21 driven from any suitable drive (not shown) and geared together by toothed wheels generally indicated by reference numeral 29 so as to rotate as indicated by arrows in Fig. 3. The pre-digested material passes from an inlet 22 to and between a first pair of rollers 21 formed by the uppermost and the second of the said rollers. Baffles 23, one of which also acts to scrape the material from the uppermost roller, divert the material so as now to pass between a second pair of rollers 21 formed by the second and third of said rollers; scrapers 24, one of which also acts to scrape the material from the second roller, divert the material so as now to pass between a third pair of rollers 21 formed by the third and lowermost of said rollers. Baffles 25, one of which acts to scrape the material from the third roller, divert the material to an outlet diagrammatically indicated at 26. The rollers 21 are fixed on shafts 27 rotatably mounted in the side walls 28 of the device, the front wall being omitted in Fig. 2, to render visible the interior of the device. It will be appreciated that with the pressure device of Figs. 2 and 3 the material is three times passed between pairs of rollers, the second roller being common to the first and second pairs of rollers, and the third roller being common to the second and third pairs of rollers. Instead of passing the material three times between pairs of rollers, it may be passed only once or twice or more often than three times between pairs of rollers. By the rolling treatment it is achieved, first that the water content of the pre-digested material is reduced by at least one third and, second, that the fibres are flattened and the material is converted into a substantially uniform mass of a somewhat pulp-like nature.

The rolled mass is then transferred from the pressure device 2 to an impregnating vessel 3 (see Fig. 1) in which the mass is intimately impregnated with a solution of an inorganic salt or salts. A wide choice of inorganic salts is available for the impregnation as well as are reagents for the precipitation. For example, soluble or partly soluble calcium salts, such as calcium hypochlorite, calcium chloride and calcium hydroxide, and barium salts may be used for the impregnation, and insoluble sulphates may be precipitated within the mass by adding sulphuric acid or acid salts such as aluminium sulphate. To facilitate impregnation, the vessel 3 may be provided with any suitable means 31, which may for example comprise a screw-mixer, for intimately mixing the mass with the impregnating material.

From the impregnating vessel 3, the impregnated mass is transferred to a dilution and precipitation tank 4, provided with stirring means 41. Before the precipitation is carried out in this tank, the impregnated mass is diluted to form a slurry and a sufficient quantity of the acidic precipitating agent is then added to reduce the pH value of the slurry to between 3 and 5. If an alkaline salt is used for the impregnation and aluminium sulfate is used as the precipitating agent, aluminium hydroxide, as well as the insoluble sulphate, are precipitated within the slurry. As another example, insoluble carbonates may be precipitated by the addition of ammonium carbonate or sodium carbonate or by bubbling carbon dioxide through the slurry. If the fibrous raw material has been pre-digested with calcium hydroxide, barium hydroxide or any other hydroxide of an alkaline earth, the impregnating step may be omitted, and calcium carbonate may be precipitated by the introduction of gaseous carbonic acid or ammonium carbonate into the slurry obtained by subjecting the pre-digested mass to the rolling treatment and by subsequent dilution. Particularly hard boards have been obtained from fibrous materials treated in this manner.

It will be apparent that the quantity of precipitate may be accurately varied whereby a wide range of different types of boards or the like may be obtained.

After the precipitation has been effected, various colouring agents or pigments may be added to the acidified pulp if it is desired to produce coloured boards or other articles. If desired, an inorganic filler, such as china clay, may be added to the vegetable fibrous material before or after pre-digesting it.

Boards, sheets, or other articles may be formed in any known manner from the slurry, which may now contain approximately 5 to 10 per cent by weight of solids. The forming of the boards or the like is performed in a forming device 5, to which the material is now transferred. For example, the forming device 5 may be a mould of any desired dimensions and any desired suitable shape, the slurry being poured into such mould. The mould may be perforated at its bottom so that a large quantity of water is extracted from the pulp through the perforations of the mould, first by gravity and subsequently by the application of a vacuum. A further amount of water may be removed by applying a pressure of up to 300 lbs. per square inch. Alternatively, the slurry may be further suitably diluted and poured on to a travelling endless wire mesh of the forming device 5, which mesh is similar to those used in Fourdrinier machines for the paper manufacture, thus forming wet mats on such wire meshes. Again, a large quantity of water is extracted from the slurry through the wire mesh and a further amount of water is removed by applying vacuum and pressure. From the forming device 5 the article formed is either transferred to a hydraulic press 6, where a hot pressing is applied at a pressure of up to 500 lbs. per square inch, or the article is transferred to a drying oven 7, where it is dried by the application of heat without pressure. The density of the article will depend on the pressure applied; if no pressure or a very low pressure is applied, the article will have a comparatively low density.

The mould, if used, may have a shape suitable for the production of boards or sheets. It will, however, be appreciated that the mould may have a different shape so as to permit other shaped articles to be produced.

According to a further essential feature of the invention, the moisture resistance of the dried boards, sheets, or other articles is considerably improved by subjecting them additionally to heat for about 6 to 24 hours at a temperature of about 100° to 160° C. For this purpose, the articles are transferred from the hydraulic press 6, or from the drying oven 7 (as the case may be) to a similar chamber 8 or 80 respectively in which the additional heat treatment is performed. The

finished articles leaving the chamber 80 are made of a material of low density, while those leaving the chamber 8 are made of a material of higher density.

In a specific example, sawdust is predigested by mixing it with ten times its weight of a 1.5 per cent caustic soda solution and treated for three hours at a steam pressure of 40 lbs. per square inch in any suitable pressure vessel 1 (Fig. 1). After completion of this pre-digestion the material is washed to remove the excess of caustic soda and is then discharged. It will be found that its water content is about twice the weight of the dry fibres. The pre-digested material is now subjected to pressure by passing it through the nip of a pair of heavy cast iron rollers 21 of the pressure device 2, the gap between the rollers 21 having been adjusted to 0.01". This operation is repeated twice and it will be found that the water content of the pulp-like mass is now 50% by weight or less. Thereafter, the mass is impregnated by means of a screw-mixer 31 of the impregnating vessel 3 with a previously prepared 5% solution of calcium hypochlorite, the quantity of hypochlorite used being equivalent to 10% of the weight of the dry fibres.

After the impregnating process has been completed the resulting pulp-like mass is diluted with water in the tank 4 until the concentration of the solids in the slurry so obtained amounts to 7%. Under continuous stirring by the stirring means 41, a solution of aluminum sulphate is added in a quantity sufficient to reduce the pH value to 4.5, whereby insoluble sulphates are precipitated.

The slurry is now ready to be shaped in the forming device 5 in accordance with standard practice. Some water may be extracted and the material is then subjected to a drying process in the drying oven 7, or is dried under pressure between heated platens of a hydraulic press 6. Subsequently, the dry boards, sheets, or other articles so obtained are additionally subjected for 20 hours to a temperature of about 125° C. in the chamber 80 or 8 respectively.

Boards and the like produced in the manner described may be treated in a variety of ways in order to make them adaptable to a number of different uses. They may, for instance, be faced with wood veneers. Alternatively, they may be faced with resinous enamels or with resin-impregnated and coloured sheets of paper before or after hot pressing, whereby sheets with highly glossed surfaces may be obtained which may be used as tiles.

Owing to the high resistance to wear, boards or the like may also be used as flooring material.

The boards or the like may be worked in a manner similar to that in which hard wood is worked.

I claim:

1. The manufacture of a water-repellent, rigid, product of great dry and wet strength from fibrous vegetable material, which comprises the steps of mixing the fibrous vegetable material with substantially ten times its weight of a 1.5 per cent caustic soda solution and subjecting the mixture for about three hours to a steam pressure of substantially 40 pounds per square inch to form a pulp, washing the pulp to remove an excess of caustic soda, reducing the water content to about 50 per cent, mixing a 5 per cent solution of calcium hydroxide to the pulp in a quantity of the hydroxide equivalent to about 10 per cent of the dry fibrous material, diluting the pulp with water to form a slurry, stirring the slurry, adding to the slurry while being stirred a solution of ammonium carbonate in a quantity sufficient to precipitate substantially all the calcium of the calcium hydroxide as calcium carbonate, subsequently forming the articles, thereafter drying the articles, and then subjecting the dried articles to an additional heat treatment at a temperature between and including 100° and 160° C. for about 6 to 24 hours.

2. The manufacture defined in claim 1, wherein as fibrous vegetable material sawdust is employed.

3. The manufacture defined in claim 1, wherein as fibrous vegetable material straw is employed.

References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
354,477	Just et al.	Dec. 14, 1886
1,693,715	Kobbe	Dec. 4, 1928
1,785,544	Ellis	Dec. 16, 1930
1,818,039	Busch	Aug. 11, 1931
1,842,712	Bradley	Jan. 26, 1932
1,941,536	Boehm	Jan. 2, 1934
1,991,499	Drewsen	Feb. 19, 1934
2,009,597	Weber	July 30, 1935
2,019,452	Hartford	Oct. 29, 1935
2,028,080	Stern	Jan. 14, 1936
2,080,437	Rafton	May 18, 1937
2,134,963	Weber	Nov. 1, 1938
2,189,832	Rafton	Feb. 13, 1940
2,208,511	Ellis	July 16, 1940
2,315,892	Booth	Apr. 6, 1943
2,338,602	Schur	Jan. 4, 1944
2,378,113	Van de Carr	June 12, 1945
2,457,797	Craig	Jan. 4, 1949
2,530,986	Moses	Nov. 21, 1950
2,554,934	Ayers	May 29, 1951
2,599,091	Craig	June 3, 1952

FOREIGN PATENTS

Number	Country	Date
404	Great Britain	of 1869
2,251	Great Britain	of 1883
443,534	Great Britain	Mar. 2, 1936