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1,892,873

PROCESS OF SURFACING BOARD AND ARTICLE THEREFOR

Filed June 9, 1928



Figure 1.



Figure 2

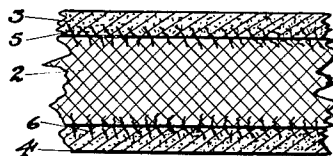


Figure 3.

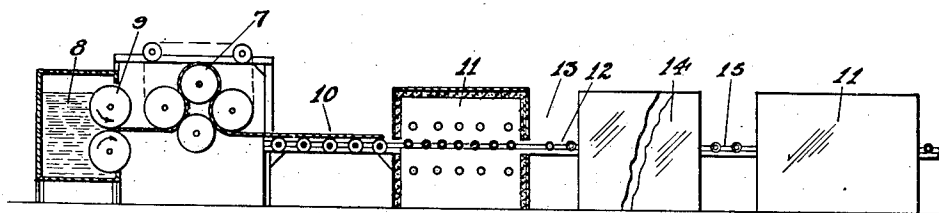


Figure 4.

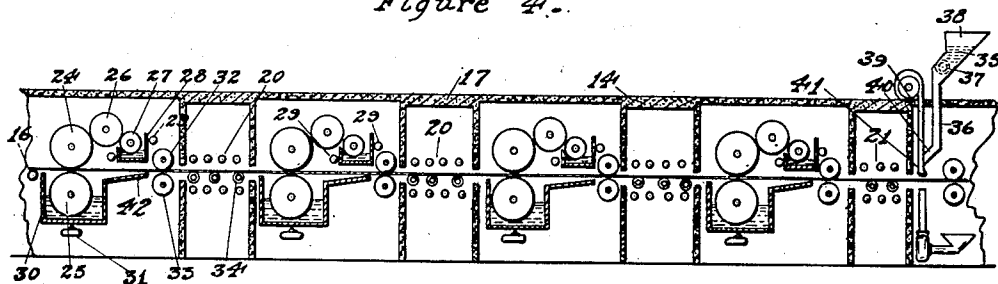


Figure 5.

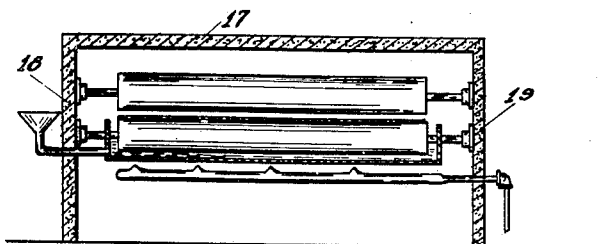


Figure 6.

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PROCESS OF SURFACING BOARD AND ARTICLE THEREFOR

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This invention relates to a process of surfacing board, the product of said process and the equipment devised for carrying out said process.

5 Some of the objects of this invention are to produce a strong, durable but light board at a low cost and with a minimum of equipment.

10 Other objects of this invention are to produce a board having a greater flexibility than is customary with present boards. This invention also discloses a means of producing a board which is a more suitable base for holding plaster or other finishes. This
15 invention gives a board which is water resisting or water-proof. Other objects of this invention will be apparent in the disclosure which follows in this specification.

20 In the specification and claims the term "board" is used to denote a material having a relatively large ratio of surface to volume and a relatively small thickness compared to its surface dimensions. The invention is applicable to such materials as are now known
25 as wallboards, straw boards, fibre board, cardboard, chip board and related products. The exact thickness of the board to which this invention may be applied is not of prime importance. For purposes of illustration, the
30 invention will be discussed as applied to cellulose containing wallboards which normally average between three-eighths and one-half inches in thickness and are made from felted cellulose fibres. Boards of this class
35 are made from wood pulp, bagasse, straw, licorice root, peat, corn stalks and various other cellulose materials. I do not wish to confine this invention to any particular kind or type of board as obviously it can be applied to advantage to the boards mentioned,
40 as well as many others which have been omitted because of the large number of different types.

45 This invention is applicable primarily to boards containing appreciable quantities of cellulose with other materials since some of the processes and reactions disclosed depend upon presence of cellulose material. Some
50 of the phases of this invention, however, are

broad enough to cover other applications as will be evident from the disclosure.

It is now customary to produce boards in the class described with a substantially uniform texture throughout. In other words, 55 boards of this class are ordinarily produced with an interior composition substantially identical with the exterior condition. In the case of the felted fibres, a simple felt is produced by well known methods from a mixture
60 of the desired fibre with certain sizing materials.

In present boards, it is customary to produce a relatively soft board for a number of reasons. The softness of the board means 65 with present methods a light board for a given thickness. Since the board is light it contains relatively small amounts of material and, therefore, involves a lower cost than a denser or harder board. The lightness of
70 the board also serves to reduce freight and handling expenses and of course gives a measure of insulation which adds to the usefulness of a board.

At the same time the lightness of the board 75 involves a weakness since the board is relatively soft and easily broken or torn. The porous structure also renders the board somewhat absorbent of water and as a result, the board cannot be considered water-proof. 80 This virtually requires a limitation of application of present boards to instances where they will not be exposed to normal weather condition.

My invention involves the means at relatively small expense of applying a surface coating to the boards also composed largely of cellulose material, the coating making the board much harder at the surface than on its interior. 90

The coating may be applied to one or both surfaces or of course, if desired to the edges although ordinarily this is not required.

It will be apparent that a board having a strong tough surface is much more durable 95 than a board having a soft surface of the same material as the interior. The addition of the hard surface gives the board strength against bending or deforming at exactly the point where the strength is required. For 100

example a board which might be made hard in the interior and soft on the surface would have much less strength than a board hard on the surface, since in bending or deforming the board the fibres on the surface are subjected to the greatest strain.

It will also be apparent that if the surface of the board can be protected from the entrance of water that the board will have a much wider field of application. It will be apparent that the additional material and additional weight required to increase the strength of the surface of the board will be very much less than the materials required to produce a similar degree of strength throughout the entire cross section of the board. Further by forming a surface which interlocks with the fibres which make up the interior of the boards, the strength of the composite material is greatly increased.

Referring to the drawing:

Fig. 1 indicates a cross section of a present type of commercial board produced from fibres in the usual commercial manner;

Fig. 2 indicates a cross section of the board made in accordance with one form of my invention;

Fig. 3 shows on an enlarged scale a cross section of one form of my board and indicates a surface layer interlocked with the interior fibres;

Fig. 4 shows in elevation and diagrammatically a board making machine operating in accordance with my invention;

Fig. 5 shows in vertical elevation also diagrammatically one form of carrying out my process and the equipment employed;

Fig. 6 is a vertical end elevation in section of the equipment shown in Fig. 5.

Referring to the drawing, 1 indicates a present form of commercial board while 2 indicates a board made in accordance with my invention. 3 and 4 indicate the surface coating which is shown interlocked with fibres 5 and 6. 7 indicates a standard commercial type of felting machine and shows a stock box 8 containing the fibres in suspension in water, the making rolls 9 and the finished felt 10 leaving the making machine. 11 indicates a dryer which may be of any commercial type and is shown diagrammatically as any device for removing water from the felted board. The dried board leaving dryer 11 is shown at 12 passing through the inspection section 13 into surfacing machine 14. The board leaves surfacing machine 14 on a series of conveyor rolls 15 and travels through dryers and cutting machines or other standard equipment not shown. Cutting machine 14 is provided with a series of rollers 16 which serve to convey the board through the treating device. The device is preferably enclosed and insulated by walls 17, 18 and 19 which insure maintaining the desired temperature and desired atmosphere within the

cutting device. A series of heating members 20, 21, 22 and 23 are used to assist in drying and maintaining the desired temperature within device 14. On entering device 14 the board passes through a pair of rolls 24 and 25 which serve to supply a slurry of definite composition as later described. Upper roll 24 is supplied with slurry from intermediate roll 26 which connects with supply roll 27 which rotates in container 28, containing the desired liquid. Container 28 is supplied with heat from steam coils 29 or other source as may be desired. Lower roll 25 rotates directly in tank 30 which is supplied with heat from member 31. The heating members may to advantage be controlled thermostatically in order to insure a uniform temperature at all times. Container 30 is provided with a drip extension 42 to drain back into the container any of the treating liquid which may drip off. It will of course be understood that the rolls, containers and associated parts exposed to corrosive materials will be formed of proper non-corrosive ingredients such as lead, monel, glass, etc.

After passing between treating rolls 24 and 25, the board travels forward in the direction shown by the arrow and passes between working rolls 32 and 33. These rolls are revolved in such a manner as to cause a rather rapid relative travel between the board and the surface of the roll. They may travel either in the same direction as the travel of the board, but at a higher velocity or they may travel in the opposite direction as desired. The object of the rolls 32 and 33 is to work the surface of the board and also in some cases to leave the board with a smooth polish. In applying many solvents an advantage is found in rubbing or working the surface fibres while in contact with the slurry as this appears to assist in the reaction upon the cellulose.

24 indicates one of a series of rollers which serve to convey the board through the treating process. A series of treating units are shown in Figure 5 and inasmuch as the various units are substantially identical in principle no description of the other units will be given. 35 indicates a hopper containing powdered material while 36 is a duct or channel by which such material may leave hopper 35. 37 indicates a flow control device such as a feeder and is used to control the rate at which the material 38 in hopper 35 is applied to the surface of the board. 39 indicates an air line, 40 an air valve and 41 a nozzle for applying powder 38 to the surface of the board. This equipment may be duplicated for applying powder to the underside of the board in a similar manner.

In carrying out the process which I have invented, I have found that it is advisable to limit the depth to which the materials used may penetrate the board. For example if I

wish to gelatinize the surface fibres of a felted board, I have found that if applied in the form of a liquid the gelatinizing material will rapidly penetrate the entire board. For
 5 example if I use sulphuric acid with a concentration of two parts of acid to one part of water, I may obtain a very effective solution of the cellulose material, but if applied in a liquid form the reaction proceeds irregularly
 10 and results in forming deep holes or pits in some parts of the board, while attacking other parts only slightly. Further the reaction is only controllable as to time and a very slight variation in the duration of con-
 15 tact between the acid and the board will cause wide variations in the result. A free solution under certain conditions may char the fibres.

The above conditions would naturally be
 20 expected in treating a material which in a way resembles blotting paper and is highly absorbent of most liquids.

In order to overcome this result and produce a controllable coating, I have found
 25 it expedient to mix with the treating liquid a carrier which may be of fine powder, a viscous liquid or a gelatinous material. For example in the case of sulphuric acid, I have found that commercial gypsum (plaster of
 30 Paris) forms a very effective material when added in such amounts that the resultant mixture is about as thick as cream. Under these conditions, the attraction between the slurry and the acid balances the attraction between
 35 the acid and the board, thus controlling the depth of which the reaction may proceed and retarding the reaction sufficiently to make it readily controllable while, at the same time utilizing concentrated materials. It
 40 will be evident that the addition of water to the acid would dilute the acid and retard the rate of reaction but not the depth of penetration. The equivalent addition of water, I have found, in no way serves the purpose
 45 of the addition of the viscous materials as described.

It may be noted that burned gypsum (plaster of Paris) does not readily set when used in this mixture probably because the neces-
 50 sary transfer of water is prevented and the growth of crystals eliminated. In place of gypsum I may add clay of various kinds, fuller's-earth, finely powdered silica or any one of a large number of materials which
 55 are relatively inert in the presence of the gelatinizing material and serve to form a plastic viscous slurry. I may also add thick liquids such as glycerin although these are not ordinarily so available as the solids. In
 60 the case of other solvents than sulphuric acid, I have found a solution of zinc chloride preferably containing free hydrochloric acid preferably mixed with fuller's-earth very effectively, particularly if slightly warm. I
 65 have also found that a solution of copper

oxide in ammonia produced in the well known way and mixed with aluminum hydroxide makes a very effective slurry. I may also use caustic alkalies such as sodium hydroxide
 70 carrying in solution aluminum hydroxide or other gelatinous or slurry forming materials. I have also found that a solution of fine ground lime in caustic soda makes a very effective alkaline slurry as well as a slurry
 75 of ground caustic burned magnesite containing sodium hydroxide in solution, as the liquid material.

From the above discussion, it will be apparent that the desirable elements in the
 80 slurry which I use consist of a medium for attacking the cellulose, carrying a thickening or retarding medium. Various modifications or additions may be made as for example in the case of sulphuric acid I may add an
 85 amount of nitric acid which materially hastens the reactions, but introduces some difficulties otherwise, by reason of the fumes produced.

In carrying out my process, I find it to
 90 advantage to first apply my slurry as described above uniformly over the entire surface of the board or sheet. I may apply this to one or both sides of the sheet depending on the required application. The slurry is
 95 then allowed to stand in contact with the sheet for a definite period while the sheet travels forward through the process machine. The next desirable step is to agitate or rub the surface of the board which results in
 100 rubbing the slurry into the pores and produces a somewhat more uniform and deeper reaction. During this time the board is maintained in a warm atmosphere at a controlled temperature with the desired humid-
 105 ity preferably to prevent the material loss or gain of moisture from the slurry. It will be apparent that if desired I may omit the rubbing or working action and still come within the spirit of my invention as the effective-
 110 ness of this step depends upon the texture and composition of the board as well as the nature of the slurry and the desired surface.

I may next remove the excess slurry by
 115 treating rolls similar to 24 and 25, but supplied with a washing solution instead of carrying a slurry. The washing solution may either be water or a solution of a salt in water as for example in the case of the treatment of
 120 the board with sulphuric acid, the washing solution may be a soluble sulphate dissolved in water as for example sodium sulphate. The advantage of a concentrated solution of this kind lies in the fact that it removes the
 125 excess of slurry and does not necessarily dissolve large amounts of acid. I may of course if desired use other solvents or only pure water. The next step consists in applying the neutralizing material. This may be an alkaline slurry in case the first slurry applied
 130 is acid in character or if the first slurry ap-

plied is alkaline this slurry would be acid in character. In some cases I prefer to apply the neutralizing slurry without a previous washing, as I thereby obtain a more active combination between the gelatinous cellulose compound and the neutralizing slurry.

In case I wish to prepare a surface which contains the minimum amount of mineral ingredients and the maximum amount of cellulose, I prefer to remove the first slurry, wash the surface and apply the second slurry following it by a second washing. In some cases, I find it highly expedient to prepare a surface containing large amounts of mineral ingredients as for example in soluble sulphates, chlorides, oxychlorides, oxides in which case I may omit the washing action.

For example if I first treat the board with a slurry which consists of zinc chloride, hydrochloride acid and fuller's-earth then work the surface of the board and finally apply a slurry of caustic burned magnesite mixed with sodium hydroxide in water, I obtain a resultant surface which contains cellulose, partially treated fibres and magnesium oxychloride. This gives a strong, hard and closely adhering surface, the thickness of which is readily controllable by varying the time of treatment, concentration of the ingredients used and other factors.

It will be noted, therefore, that this invention contemplates a hard surface formed upon a board, the surface containing appreciable amounts of cellulose. I have outlined various methods of obtaining such a surface in order to show the scope of my invention and various other compositions and types of surfaces may readily be made by those skilled in the art without departing from the scope of my invention.

It should be understood that my invention is not confined to any special thickness or type of board, although I prefer to apply it primarily to boards containing relatively large percentages of cellulose in other composition. The presence of other materials in a board does not of course preclude the carrying out of my invention. I may face either one side or both sides of the board, but do not wish to be confined to any special arrangement in this matter. In using the term "acid" and "alkali" I am employing them broadly and by referring to cellulose dissolving material I intend to indicate those materials which attack and combine with cellulose although many of them do not form a true solution in the strict sense. These features are well known to those skilled in the cellulose industries.

The factor of working or rubbing the surface of the board appears to be very helpful in obtaining a smooth uniform coating, but is not essential in carrying out the process of my invention.

It will be apparent that in addition to de-

vising a new process for treating boards and an apparatus for carrying out this process, I have also invented a new board which has novel and desirable characteristics compared to boards now available on the market, and I consider the product part of my invention.

It will be apparent that if desired, I may neutralize the coating first applied by a spray of liquid or of dust or powder although I prefer the roller method already described. However, it will be apparent that the resultant board which I have invented may be obtained by such a method. In the case a liquid is sprayed onto the board, it would be of course of such a nature as to neutralize the first coating. In other words, if I should use a first or priming coat of sodium silicate which of course has an alkaline reaction, I may spray sulphuric acid, alum or any other desired precipitant upon the surface. In case a solid dust is applied I may use lime, magnesium oxide, barium oxide, the hydroxides of these metals, etc. Obviously modifications will be apparent to those familiar with the chemistry involved. On the other hand, I may in some cases omit entirely any neutralizing of the surface layer allowing the material added to the surface of the board to in effect neutralize themselves by reacting with the board. For example when a slurry of sulphuric acid carrying calcium sulphate in suspension is added to the surface of the board and removed, the surface becomes hard and dense without neutralization.

One method of treating the surface of the board, which I have found very satisfactory, consists in first adding a solution of sodium silicate preferably containing an excess of caustic soda, but not necessarily so. Such a solution when not directly attacks the cellulose forming a jelly or semisolution. By then adding to the surface of the board after the application of the silicate solution, (and permitting proper time interval for the reaction to take place) a concentrated sulphuric acid slurry or solution, I am able to precipitate in the surface layer of the board a mixture of silica, calcium silicate, gelatinized cellulose and cellulose fibres. This mixture adheres strongly to the fibres and the balance of the board and when polished by a rapidly revolving roll rubbing on the surface of the board gives a smooth, hard finish of the type which I had invented. If the polishing roll is hot the surface usually hardens more rapidly and gives a more uniform surface.

If desired I may add color or stain such as oxides or dyes, thus producing a board having a colored surface. For example by adding ferric compounds to the sulphuric acid slurry, I am able to produce a board having a rich reddish brown color which

somewhat resembles mahogany. Various other colors may be produced at will by the addition of proper ingredients.

It will be apparent that more rapid action will take place in the case of the various materials applied in case the board is kept warm and further the final drying will proceed more rapidly and more uniformly in case the board is warm during treatment.

It should be understood that the order in which the various reagents are added to the surface of the board is in some cases of great importance.

For example in the case of the coating formed by precipitating a soluble silicate among the surface fibres this result is readily obtained if the silicate solution is added to the board while if the acid solution is first added to the board the silica precipitate forms above the board and will not adhere to the surface nor form a coating with the fibres. In general it may be stated that the material first added to the fibres will be the one which will supply the major portion of the ingredients in the precipitated film.

It will be understood that where mention is made of acids or alkaline, I do not wish to be restricted to free acids or alkaline as used in the ordinary sense, but rather intend to convey the idea of mediums which have an acid reaction. For example alum, ferric chloride or various other easily hydroxized salts will in many cases produce the same effect as a free acid. In the same way many salts may produce the effect of a free alkali as for example sodium silicate or combinations of a strongly basic element with a weakly acid radical.

Having now fully described my invention what I claim as new and wish to secure by Letters Patent in the United States is as follows:

1. An article of manufacture consisting of a board of material thickness composed mainly of cellulose material having an absorbent core and with a hard surface containing chemically altered cellulose.

2. An article of manufacture consisting of a board of material thickness composed mainly of cellulose material with a soft core and a hard surface composed of altered cellulose mixed with mineral material.

3. An article of manufacture consisting of a board of material thickness having an interior of relatively soft and porous structure and a surface of relatively hard and dense structure, containing chemically altered cellulose and mineral material.

4. An article of manufacture consisting of a board of material thickness composed mainly of cellulose material having an interior portion with a relatively porous and absorbent structure and a chemically altered surface which is relatively dense, smooth and water resisting.

5. A board of substantial thickness formed mainly of interlocked cellulose fibres in the interior with a surface consisting largely of cellulose fibres intermingled with an insoluble compound of silica.

6. A board formed mainly of cellulose fibres having a relatively soft interior and a relatively hard smooth surface containing a mixture of chemically altered cellulose and mineral matter precipitated together.

7. The process of treating the surface of cellulose board to a controlled depth which consists in first applying to the surface of the moist board a limited quantity of the slurry containing a cellulose dissolving material, second working said surface, third removing the excess of said slurry and finally drying said board in a substantially flat condition.

8. The process of manufacturing cellulose board which consists in forming said board from a liquid suspension of fibers, pressing and partially drying said board and finally applying a slurry containing cellulose dissolving material, allowing said slurry to act for the desired period upon the moist surface of said board and then drying said board while substantially flat.

9. The process of forming a cellulose board which consists in felting the fibers composing said board, pressing said felting fibers and removing some of the moisture contained in said web then applying to the surface of said moist board a slurry containing cellulose dissolving material and after allowing said slurry to act upon the board to a controlled depth, neutralizing said slurry and drying said board in a substantially flat position.

10. The process of forming a board having a hard surface and a porous interior which consists in felting the fibers for said board into a web, pressing and partially drying said web, applying a slurry containing cellulose dissolving material to the moist surface of said web until the surface is transformed while the interior is substantially unaffected, and finally neutralizing the excess of said slurry and drying said board while substantially flat.

11. The process of forming board which consists in felting the fibers from a water suspension, pressing the resultant web, rolling into the surface of said resultant web while still moist a treating slurry, and finally drying said resultant product on a series of moving rolls at an elevated temperature.

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