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A. ELMENDORF

2,312,831

INDURATED FIBROUS MATERIAL AND PROCESS OF MAKING THE SAME

Filed June 22, 1940

Fig. 1.

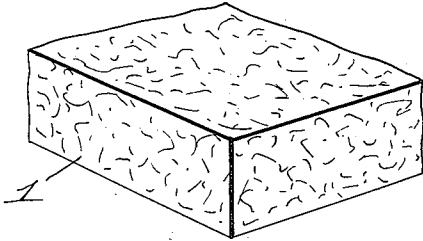


Fig. 2.

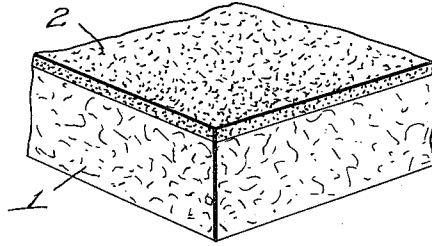


Fig. 3.

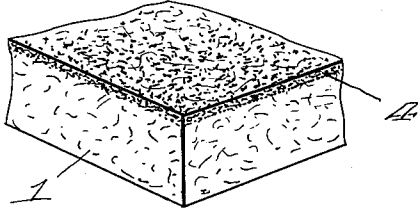


Fig. 4.

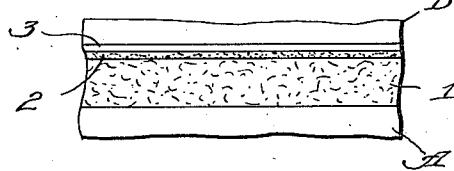


Fig. 5.

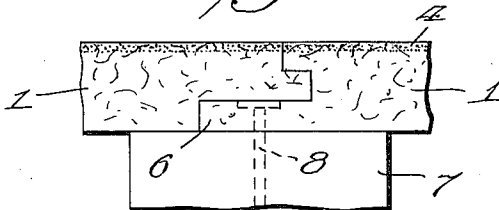


Fig. 6.

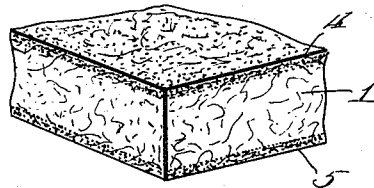


Fig. 7.

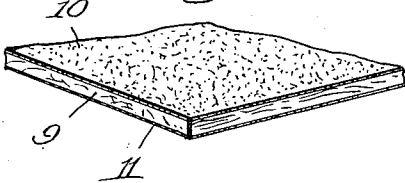
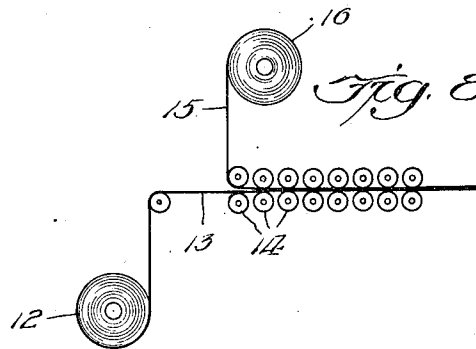


Fig. 8.



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UNITED STATES PATENT OFFICE

2,312,831

INDURATED FIBROUS MATERIAL AND PROCESS OF MAKING THE SAME

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15 Claims. (Cl. 117—65)

Artificial boards or panels of the low density, fibrous insulation board type cannot successfully be employed in buildings or other structures in places where the characteristics of hardness, stiffness and resistance to weather found in wood are required. The primary object of the present invention is to make it possible to use this type of material in many places for which it has not heretofore been available by providing boards or panels composed thereof, at a reasonable cost, with faces that are hard and tough, that are much more weather-resistant than are the virgin faces, which readily take paint and which add very substantially to the stiffness of the boards or panels.

In the expectation that if a fibrous board could be impregnated, in whole or in part with a suitable water-proofing material that would harden and give strength and stiffness to a board, I experimented with many indurating substances and discovered that some which may be included in the description "hardwood pitch" possess the necessary properties, provided that they can be successfully introduced into the boards. Hardwood pitch which may be the result of vacuum distillation of hardwood tar and has a melting point, by the cube in air method, of from 90° C. to 100° C., or a pitch which is a condensation of heavy phenolic wood oils with certain aldehydes occurring in the pyroligneous acid and which has a melting point of from 105° C. to 110° C., may be used. But, if the pitch is simply melted, it will not penetrate the fibrous material when applied thereto in any usual way, as by submersion. When it is attempted to effect penetration by giving to the pitch a temperature substantially above the melting point, it is largely converted into vapors which are dissipated in the atmosphere and only a charred residue is left on the surface of the fibrous materials. As I have succeeded in causing hardwood pitch to penetrate into the interior of low density fiber board, in a simple and inexpensive manner, what I have done may be regarded, in one of its aspects, as a discovery of a novel method of indurating porous, fibrous materials, such as insulation boards or porous sheets of which kraft paper is an example, with hardwood pitch.

I have found that by pulverizing solid hardwood pitch and spreading a layer of the powdered pitch upon the surface of a board or panel, the pitch may be driven into the latter by means of heat and pressure applied while the pitch is confined in contact with the board or panel and is prevented from escaping into the surrounding

atmosphere in the form of fumes. In the case of large boards or panels, the confining of the pitch and the fumes evolved therefrom may be effected by simply laying a caul on top of the layer of powdered pitch and applying the heat and pressure through this caul. The caul may be a metal plate of the same area as the board or panel, or it may simply be one of the platens of a hot press. The pitch must be heated to a temperature much higher than the melting point of the pitch, so that the pitch becomes very fluid and is vaporized to some extent. A little of the liquid may ooze out from between the caul and the board or panel around the edges but, in the case of large commercial panels and boards, the loss from this is so small as to be almost negligible.

In the case of a pitch having a melting point of 110° C., I have found that when the process is carried out at a temperature of 160° C., the pitch does not pass into the board or panel but remains on the surface. However, at a temperature in the neighborhood of 190° C., good penetration is secured in about four minutes; the time required to effect successful penetration increasing with a decrease in the temperature below 190° C. Temperatures up to about 260° C. have been employed satisfactorily. Pitches having a melting point around 95° C. cannot be driven into fibrous insulation boards at temperatures below 140° C., but must be heated to higher temperatures. Thus, at a temperature of 175° C., good penetration can be obtained in about three minutes. As the temperature is lowered below 175° C., the time required to secure proper penetration increases. The temperatures of 190° C. and 175° C., here given, are what may be termed optimum temperatures, a considerable range in both directions therefrom being permitted.

Subjected to these high temperatures, while exposed to atmosphere, the volatile matters of the pitch are driven off in the form of vapors and only a charred residue remains. In the carrying out of my process vapors are evolved but, since they cannot escape in any other direction, they pass into the porous board or panel, carrying with them or driving ahead of them such portion of the pitch as still remains in liquid form. The result of the treatment of the board or panel is to drive practically all of the pitch into the interior of the latter, no coating in the form of a film or flakes being visible on the surface of the material when removed from the press. Furthermore, when the impregnated portion of the treated material is examined under the micro-

scope, it is apparent that the pitch does not enter the board by simply filling the voids in the fiber board and thus forming tiny pools, because the voids still remain and the dissipation of the pitch is shown as having occurred in the form of coatings for the individual fibers. In other words, the impregnated portion of the fiber board material has very much the appearance of having been formed or manufactured from coated fibers.

In carrying out the process, no great amount of external pressure is permitted because the board must not be crushed, as it is desirable to retain the insulating value of the original board. In the case of a board or panel that is originally three-quarters of an inch thick, there is apparently no advantage in exerting a greater pressure than one which will result in a reduction of the thickness by about one-sixteenth of an inch. Where the powdered pitch is applied to a three-quarter inch panel, in a layer about one-tenth of an inch thick, it penetrates uniformly to a depth of about one-sixteenth of an inch below the surface, namely to a depth somewhat less than the thickness of the original layer of powdered pitch.

When the panel cools, after being treated, the pitch becomes hard and provides the treated side of the board or panel with a stiff, hard face. In fact, the characteristics of boards or panels treated in accordance with my process are such that the indurated sides may be exposed to the weather in sidings for buildings or other structures, because they are weather-resistant and are tough and stiff enough to withstand the usual pressures and blows which they may be expected to receive. While the impregnated portion of the fiber board material is not entirely waterproof, yet it is much more so than the virgin fiber board material because each fiber is waterproofed. Also, since the impregnated surface will take paint readily, ability to resist the entrance of water need depend only on the use of a good paint, since the siding as a whole will be as resistant to the entry of water as is the paint itself.

After the material leaves the hot press and cools, it appears to have a permanent shape which does not appreciably change under normal changes in temperature and atmospheric humidity. For example, if the board or panel be flat, after it has become cool, it afterwards remains flat. Since the fibrous boards or panels are flat before they are subjected to the indurating process, it is only necessary that they be kept flat until they have cooled after induration. Often if a panel is removed from the press and permitted to cool without being restrained, it warps in cooling and thereafter remains warped. I have found that this objection can be overcome by constraining the board or panel while it is cooling, conveniently by transferring the panel directly from the hot press to a cold press which then keeps the panel flat until it has cooled and the pitch has hardened.

Sheets of paper for facing wood cores can also be treated in the same way as boards, although in the case of paper sheets the indurating material extends throughout substantially the entire thickness of the sheets. Sheets can conveniently be treated as they are unwound from rollers and be then rolled up again until they are to be used. Furthermore, two sheets at a time may be impregnated, each serving as a covering member or caul for the other. For example, two sheets that overlie each other and between which there is a layer of hardwood pitch, may be fed

between hot pressure rolls. It is found that the pitch passes in about equal amounts into both sheets and, curiously, upon cooling, there is no bonding together of the sheets which simply lie in contact with each other at the discharge end of the apparatus and can therefore be rolled up separately. Viewed in one of its aspects, the present invention or discovery may therefore be said to have for an object a simple method of impregnating sheets of paper with hardwood pitch or the like.

In the accompanying drawing I have illustrated more or less diagrammatically my improved materials as well as preferred methods of manufacturing the same. In the drawing:

Figure 1 is a perspective view of a fragment of a thick board or panel of the low density fibrous insulation board type; Fig. 2 is a view similar to Fig. 1, showing a layer of hardwood pitch overlying a face of the board or panel; Fig. 3 is a view similar to Figs. 1 and 2, showing the board or panel after it has been treated in accordance with the present invention; Fig. 4 is a view showing a fragment of a hot press containing the board or panel with its layer of pitch as illustrated in Fig. 2, on a smaller scale than Fig. 2; Fig. 5 is a cross-sectional view showing a fragment of the side of a building provided with an insulating siding composed of my improved boards or panels; Fig. 6 is a view similar to Fig. 3, illustrating a board or panel indurated on both sides; Fig. 7 is a perspective view of a corner of a panel comprising a wood core faced on both sides with impregnated sheets of paper; and Fig. 8 illustrates diagrammatically a method of impregnating two sheets of paper simultaneously.

Referring to Figs. 1 to 4, 1 represents a board or panel of the low density insulation board type such, for example, as the material known as "Celotex." Porous boards made of wood wool or fine excelsior bonded with mineral cements may be used. Where it is to be used as a substitute for sheathing and siding in a wooden building, the board or panel may be of a usual commercial type that has a thickness of about three-quarters of an inch. Usually it would be sufficient to indurate the board or panel from one side only, namely the side that is to be exposed to the weather. In that case the board or panel may first have applied thereto a layer 2 of hardwood pitch, preferably in powdered form about one-tenth of an inch thick, as shown in Fig. 2. The board or panel is then subjected to heat and pressure, while the pitch is kept covered so that the fumes that are generated cannot escape to any extent, except into the interior of the board or panel. The cover or caul may take any suitable form, depending upon the manner in which the heat and pressure are applied. For example, the caul may be simply a polished metal plate such as indicated at 3 in Fig. 4. The work may be placed under pressure and heat either in a press or by passing it between hot rolls. In Fig. 4 the assembly is shown as disposed between the lower and upper platens A and B of a hot press. Actually, when the work is carried out in a hot press, the upper platen may be made to serve as the caul. At any rate, assuming that the press, or at least the upper platen thereof, be hot enough to heat pitch of 100° C. melting point to a temperature of from about 190° C. to 260° C., the press is closed on the work, causing the pitch to melt and to be driven completely into the fibrous

material; the pressure being such that the fibrous material is slightly compressed, the thickness of a three-quarter inch board being reduced in the example given about one-sixteenth of an inch. The press remains closed on the work for only a short time, say, from about forty-five seconds to four minutes. The pitch penetrates into the board or panel to a depth of about one-sixteenth of an inch, as indicated by the shaded area 4 in Fig. 3.

When the pitch is applied in powdered form, it may conveniently be spread over the bottom platen of a press and be surrounded by a frame of about the same length and width as the panel and of a thickness about equal to the depth of the layer of pitch that is needed. Then, when the insulation board is laid upon the pitch, the latter cannot scatter but is confined by the low frame-like barrier. Upon closing the press, the molten and partially vaporized pitch is still confined and substantially no loss of pitch results through leakage at the edges of a board or panel. The opening in the frame surrounding the pitch on the lower platen of the press may be a little smaller than the size of the panel, so that the extreme marginal portions of the panel become compressed to permit the panel to be forced down into contact with the bed of the press. This insures a good seal between the frame and the board or panel and causes no damage to the latter because the board or panel is always trimmed afterwards.

If a hardened stratum is desired on both sides of a board or panel, it is only necessary to place a second layer of pitch between the under side of the panel in Fig. 4 and the underlying caul which may be a plate similar to the plate 3 or may be the lower platen A of the press. In that event, a second indurated stratum is created at the lower face of the board or panel, as indicated at 5 in Fig. 6. A board of the low density fibrous insulation board type treated in the manner just described is about twice as stiff as, and possesses about fifty percent greater bending strength than, a similar untreated board.

In order to cool each board or panel while it is held in a flat condition, I transfer it from the hot press directly to a cold press, not shown, and leave it in the latter until the assembly has cooled and the pitch has become hard.

In Fig. 5 there is illustrated a section of the wall of a building in which my improved boards or panels are secured directly to the studs and thus take the place of the usual sheathing as well as the siding or facing material; the indurated sides of the boards or panels being exposed to the weather if only one side of each has been indurated. By employing the overlapping, joint-forming parts of meeting boards or panels, as explained in my prior application, Serial No. 301,143, the combination sheathing and siding may be nailed to the studs without leaving any signs of nails on the exterior, if the panels are made just wide enough to span the distance between adjacent studs. In other words, one of the boards or panels may be provided with a long tongue 6 lying flat against the stud 7 and secured thereto by nails 8. The meeting board or panel is shaped along the margin to overlie the tongue 6 and, preferably, otherwise to interlock with the panel that has been nailed to the stud, so that it cannot become loose or be separated from the cooperating panel after its flange or lip 6 has, in turn, been nailed to the next stud; further security of the joint being attained by the intro-

duction of an adhesive or a heavy paint between the meeting surfaces as explained in my aforesaid application.

In Fig. 7 there is illustrated a board or panel comprising a core 9 of wood and facings 10 and 11 of paper. Paper treated in accordance with my improved process may be used to advantage for the facings of this type of lumber. Paper may be treated by a continuous process so that the cost of the treatment is not much greater than that of the pitch required. Paper may conveniently be treated two sheets at a time. Thus, for example, in Fig. 8, there is illustrated a roll 12 of paper 13 which is carried between sets of hot rollers 14 together with an overlying sheet 15 that is drawn progressively from a roll 16. If the pitch is to be applied progressively as the sheets are fed ahead, a section of the sheet 13 may be left exposed in advance of the point where this sheet meets the sheet 15, so that the pitch may be placed upon this exposed portion and be carried forward with the latter underneath the sheet 15. Each sheet acts as a caul for the other, the melted pitch passing about equally into each of the two sheets. The sheets do not become bonded together during the impregnating process and may therefore be progressively rolled up as they leave the pressure rollers, or they may be cooled or be allowed to cool before being rolled up again.

While I have referred only to the use of powdered pitch, the pitch may be applied to the boards and the sheets in any desired way. Also, where powdered pitch is employed, it may be caused to melt more or less before undergoing the final heat and pressing operation to insure that the even distribution of the pitch will not be disturbed. In the case of the paper sheets, they need only be drawn over heated rolls, with the powdered pitch lying on top of the sheets, in order to cause sufficient melting to hold the pitch in place. The pitch may be caused to form a coating adhering to the paper with sufficient tenacity to permit the paper to be rolled up until it is desired to carry out the final impregnating step.

In the process of impregnating paper sheets, approximately the same temperatures as employed in the case of boards or panels are required. The time required to complete the impregnation of sheet material is usually less than in the case of boards or panels. Thus, to indurate, through complete impregnation, sixteen point kraft paper, from fifteen seconds to sixty seconds are needed, when plate pressure is used.

While I have illustrated and described my invention with considerable particularity, I do not desire to be limited to all of the details thus illustrated and described; but intend to cover the whole field of invention as the same is set forth in the following claims that constitute the definition of the invention.

I claim:

1. A fibrous board of the low density insulating board type having hardwood pitch coating the fibers distributed throughout an outer layer of the board.
2. A fibrous board of the low density insulation board type having hardwood pitch coating the fibers distributed throughout a layer of substantial depth adjacent to each face of the board.
3. A thick board of the low density fibrous insulation board type having the fibers thereof coated with hardwood pitch for a distance of

about a sixteenth of an inch inwardly from a face thereof.

4. A thick board of the low density fibrous insulation board type having the fibers thereof coated with hardwood pitch for a short distance inwardly from each face thereof and being about twice as stiff as and possessing about fifty percent greater bending strength than a similar untreated board.

5. The method of indurating a body of fibrous porous material, for a short distance below a surface thereof which consists in covering the surface thereof with wood pitch, pressing the assembly between hot plates, and causing the pitch to melt and to be partly converted into fumes.

6. The method of indurating a porous board of fibrous material, which consists in applying to a face thereof a layer of wood pitch, and applying to the pitch, through a vapor-retaining covering member, pressure and sufficient heat to melt the pitch and to be partly converted into fumes.

7. The method of indurating a porous board of fibrous material, which consists in placing upon a face thereof a layer of hardwood pitch, and subjecting the board to heat and pressure applied through a member having an imperforate face spanning the length and breadth of the board.

8. The method of indurating a board of fibrous porous material, which consists in placing upon a face thereof a layer of hardwood pitch, covering the pitch with a caul, and applying through the caul pressure and sufficient heat to melt the pitch and to cause it to be partly converted into fumes.

9. The method of indurating a board of the fibrous porous insulation board type, which comprises placing on a face thereof a layer of hardwood pitch having a melting point of from 105° C. to 110° C., and heating the pitch to a temperature substantially above 160° C. while pressing it against the board and preventing the escape of most of the fumes into which some of the pitch is transformed.

10. The method of indurating a board of the fibrous porous insulation board type, which comprises placing on a face thereof a layer of hardwood pitch having a melting point of from 90° C. to 100° C., and heating the pitch to a temperature

substantially above 140° C. while pressing the same against the board and preventing the escape of most of the fumes into which some of the pitch is transformed.

11. The method of indurating a board of the fibrous porous insulation board type, which comprises covering a face thereof with a layer of hardwood pitch, causing the pitch to melt and to be partly converted into fumes while confined in contact with and pressed against the board, and then cooling the board while constraining it in the desired shape.

12. The method of indurating a board of the fibrous porous insulating board type, which comprises covering a face of the board with a layer of hardwood pitch, and placing the assembly in a hot press and subjecting it to some pressure and to a temperature of at least 175° C. for a period of from about forty-five seconds to four minutes.

13. The method of indurating a board of the fibrous porous insulation board type, which comprises covering a face of the board with powdered hardwood pitch having a melting point of from 105° C. to 110° C., placing on the pitch-covered face an imperforate metal plate, subjecting the assembly to pressure and to a temperature of from 190° C. to 260° C., and then transferring it to a cold press.

14. The method of indurating a three-quarter inch board of the fibrous insulation board type, which comprises covering a face of the board with a layer of powdered hardwood pitch about one tenth of an inch thick, placing the assembly in a press and subjecting it for a period of from about forty-five seconds to four minutes to a pressure sufficient to compress the board about one-sixteenth of an inch, and to a temperature high enough partially to convert the pitch into fumes, and then transferring the board to a cold press.

15. The method of indurating fibrous porous sheet material with wood pitch, which comprises laying two such sheets upon each other with a layer of pitch between them, subjecting the assembly to pressure and heating it to a temperature sufficient to melt the pitch and convert it partially into fumes, and then separating the sheets from each other.

ARMIN ELMENDORF.