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W. H. MASON

INTEGRAL INSULATING BOARD WITH HARD WELDED SURFACES

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FIG. 1.

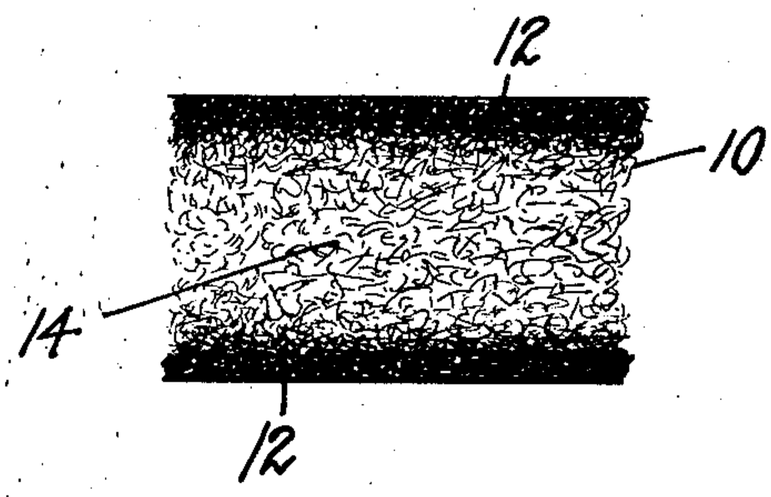
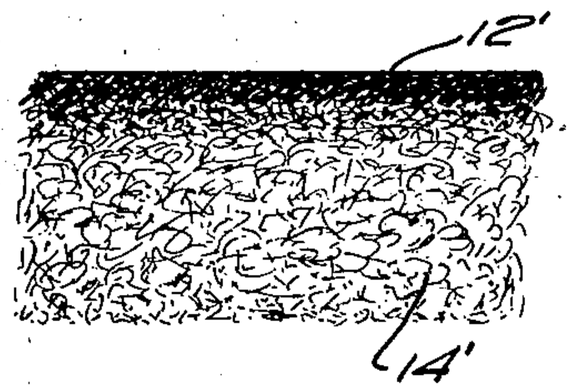


FIG. 2.



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UNITED STATES PATENT OFFICE.

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INTEGRAL INSULATING BOARD WITH HARD WELDED SURFACES.

Application filed March 1, 1926. Serial No. 91,447.

My invention relates to an integral insulating board with hard welded surfaces, and process of making same.

Ligno-cellulose materials of various kinds, such as wood and the like can be used for making my improved product, but for convenience I refer herein especially to wood as a source of material.

The principal object of the invention is the production from natural wood, such as waste pieces from saw mills, of an integral board product, the interior or backing portion of which is of relatively high porosity and is a good insulator, and the surface portion or portions whereof are hard, dense, stiff and strong, both the interior and surface portions being produced from an integral body of fiber.

Other objects will appear in the following description of my product and the process of its making.

The raw material, such as wood in small pieces or chips, is first converted into fiber. The fiber is preferably prepared by explosion from a gun through a constricted outlet or outlets under high pressure, preferably steam pressure, of about 250–1000# per square inch, but the wood may be ground or fibrated in other ways, so long as the lignins or a material part thereof are retained, and the fibers are not unduly chopped or shortened. Chemically digested fibers from which the lignins have been removed are not adapted for the purposes of my invention. To secure the best embodiment of my invention, the fiber should contain all or practically all of the original wood or woody material disintegrated into fibrous state. Without commitment to a particular theory, I believe that the lignins, which are plastic under conditions of heat, moisture and pressure hereinafter described, serve for producing a welding or coalescing of the cellulose fibers in the surface portion of my product solidly together, so that said surface portion for practical purposes consists practically of wood remade in modified form, with the fibers rearranged without grain or order, and of increased density and hardness.

After being fibrated, as, for example, by explosion from a gun, refinement as by beating and the like need not be resorted to and if there is any further refinement same is not extensive. The exploded fiber direct from the gun can be made use of, if desired, for the purposes of the present invention, without refinement.

The fiber is preferably formed into a felted sheet from a water bath, which may contain materials for making the product more waterproof or fire resistant or both.

Some of the excess water may be eliminated as by passing through squeezing rolls. This is, however, largely a matter of convenience, as the squeezing or wringing out of water, which takes place to some extent in any case in connection with the drying, can all be performed in such connection.

In the fibration and formation in water into felted sheets or the like form, the natural substantially parallel arrangement of the fibers existing in the wood is lost and the fibers become criss-crossed in various directions, so that the resulting product is grainless and of substantially like strength and stiffness in all surface directions.

The sheet or other form of fibrated material is subjected in moist form to heat and pressure. When in sheet form, the fiber sheet is cut into lengths as desired, and the sections introduced into a heated press, as, for example for the production of products which are hard surfaced on both sides, between upper and lower steam heated press platens.

When the moist fiber sheet is compressed between the hot press platens, the pressure throughout the entire fibrous mass is substantially uniform, but the heat penetrates relatively slowly from the surfaces of the hot press platens toward the interior or center of the fibrous mass in the press. The welding of the cellulose fibers by their lignins appears to take place progressively inwardly beginning from the hot platen surfaces and extending gradually inward as the heat penetrates into the interior and toward the center of the mass of fiber.

If the compression is sufficiently high and is maintained for a sufficiently long time to permit the heat to penetrate throughout the mass of fiber, this welding action will be substantially complete throughout the entire thickness of the fibrous mass as is set forth and claimed in my copending application Serial No. 57,252, filed September 18, 1925.

After an interval of time has elapsed, however, such that heat penetration and

welding extends only part way in, and the welding is not yet complete all the way through, the mass of fiber between the press platens would be found to consist of hard, dense welded surface portions separated by an interior felted portion, which, while being subjected to the same pressure as the surface portions, has not yet become welded because of the heat not yet having penetrated sufficiently to produce welding in such region.

If now the operation be interrupted, as, for example, by opening the press at this stage, the central unwelded portion will expand as the press platens are backed away, leaving the central portion of the sheet of porous felted structure and well adapted for insulating purposes. If the press platens are backed off after the surface portions of the sheet have become welded from the heat and pressure and while the interior portion has not yet welded, it is important that such release of pressure be effected gradually in order to afford an opportunity for the moisture in the form of steam to escape. If the pressure be released suddenly the sheet may explode and blow out the interior porous material along the edges of the sheet in the same way that a gasket can be blown out. Use of fiber in the form in which it comes from the gun and without much or any refinement is advantageous by reason of its elastic nature, and a good degree of porosity is obtained by expansion of the unwelded portion following pressure relief. This porosity, in addition to being desirable in the final product, is useful in assisting the escape of moisture (steam) at times of pressure relief, and in reducing the liability to explosive blow-outs.

Pressures of from 200–700# per square inch, preferably from 400–500# per square inch, have been found to give very satisfactory results in producing surface portions of desirable hardness, density and strength, but wide variations in pressure, as from about 25–1200# per square inch may be resorted to if desired to obtain density and strength in the surface portions corresponding roughly to the pressure used. When steam heated press platens are used the steam for heating the platens is preferably of a pressure over 50# per square inch, but considerably higher pressures and temperatures than this may be used so long as objectionable overheating and charring is avoided. With press platens heated by steam at about 100# per square inch and a pressure between the platens of about 400–500# per square inch a fiber sheet which is about 1½″ thick as it comes from the squeezing rolls after being subjected to the pressure for about 5–10 minutes and then the press gradually released has a thickness of approximately 1″, of which the outer ⅛″ or thereabouts on each surface is of hard, dense thoroughly consolidated and welded structure and the intervening portion approximately ¾″ in thickness is porous and of good insulating qualities. There can, of course, be a great deal of variation in respect of thicknesses and density of the product and the several portions thereof, according to requirements in connection with the use to which the board is to be put, and the time of release of the press is gauged in accordance with the particular sort of product required, the pressure being continued for a less interval where the thickness, strength and density of the surface portions is relatively less important and for longer periods when surface portions of greater resisting qualities are required.

In order to obtain desirably good welded surface portions, any give or shrinkage taking place in the body of fiber should be followed up by the press platens, and the full pressure used should be maintained throughout the body of fibrous material, until the point of time is reached at which the pressure is intentionally released.

Instead of stopping or preventing the progress of the welding action by release of pressure, the steam for heating the press platens can be cut off about or shortly before the time when the welding action has progressed inwardly for the desired distance, without releasing the pressure at such time, or the steam for heating the platens can be cut off and the pressure between the platens released at or about the same time that the source of heat is cut off. After the sheets are removed from the press the drying can be completed, as, for example, in a drier or kiln.

In the accompanying drawing Fig. 1 is a diagrammatical sectional view of a board product in accordance with my invention having dense surface portions on both of its opposite sides. Fig. 2 is a similar view of a modified form of product having but a single highly dense surface portion with a backing of felted board material.

Reference character 10 is applied to indicate the board product generally, 12, 12 indicate the hard, dense welded surface portions, and 14 the relatively porous intermediate insulating portion. Such a board is produced as above described when the body of felted fiber is pressed between heated upper and lower press platens. When, however, one of the press platens, as the lower one, is cold so that welding of the fibers does not take place in that part of the body of fibre adjacent to such cold platen and same expands after being subjected to compression, a board product is obtained as indicated in Fig. 2 having but one surface portion 12′ of high denseness and a backing portion 14′ of the felted and non-welded fibre. The dry-

ing of such product can readily be completed in the press, after the pressure is wholly or partly released.

Cognate subject-matter not claimed herein is embraced in my companion copending applications as follows: Serial No. 38,356, filed June 19, 1925; Serial No. 57,251 filed Sept. 18, 1925; Serial No. 57,252, filed Sept. 18, 1925; Serial No. 90,167, filed Feb. 23, 1926.

I claim:

1. An integral fiber product comprising wood or woody material which had been disintegrated into substantially fibrous state and containing practically all the original wood or woody material, said product comprising a dense, non-porous portion of material thickness and high strength in which the fibers are permanently coalesced together under heat and pressure, and an adjacent light porous portion integral with the first-named portion and formed from the same body of fiber.

2. An integral fiber product comprising wood or woody material which had been disintegrated into substantially fibrous state by explosion from under high pressure, said product comprising a dense, non-porous portion of material thickness and high strength in which the fibers are permanently coalesced together under heat and pressure, and an adjacent light porous portion integral with the first-named portion and formed from the same body of fiber.

3. A fiber board of coarse fibrous ligno-cellulose material exploded from a pressure over 250# per square inch, which has non-porous hard, dense, press-formed surface parts of material thickness with the fibers thereof welded and coalesced together, and an interior portion integral with the surface portions and made from the same body of fiber, and which is non-welded, porous and light and well adapted for insulating purposes.

4. The process of making a ligno-cellulose fiber product, which consists in exploding wood from a pressure above 250# per square inch, felting into sheets formed in water, pressing the moist sheet while applying heat to one side only thereof, and releasing the pressure before the heat has penetrated throughout the fiber mass, whereby a board product is provided having a dense welded surface on one side backed by a portion of felted fibre.

5. The process of making an integral ligno-cellulose fiber product, which comprises pressing a body of the fiber in moist state which had been produced by explosion from under high pressure and contains substantially all the original lignins between a heated and a cold press surface, and releasing the pressure after the heat has penetrated into but not through the fiber mass.

6. Process of forming integral fiber products comprising adjacent portions which are respectively of high density and high porosity, which comprises applying heat and pressure to a body of wood or woody fiber containing practically all the original wood or woody material until welding or coalescing of the fibers into permanent relation has extended therein to a material extent but not therethrough, and releasing the pressure whereby the portion to which welding or coalescing has not extended is permitted to expand into highly porous state.

7. Process of forming integral fiber products comprising adjacent portions which are respectively of high density and high porosity, which comprises applying heat and pressure to a body of wood or woody fiber obtained by explosion from under a high pressure and containing practically all the original wood or woody material until welding or coalescing of the fibers into permanent relation has extended therein to a material extent but not therethrough, and releasing the pressure whereby the portion to which welding or coalescing has not extended is permitted to expand into highly porous state.

In testimony whereof, I have signed my name hereto.

WILLIAM H. MASON.