Sept. 23, 1947. J. A. ROBERTSON ET AL 2,427,879

STRUCTURAL PRODUCT

Filed Dec. 22, 1943

Fig. II

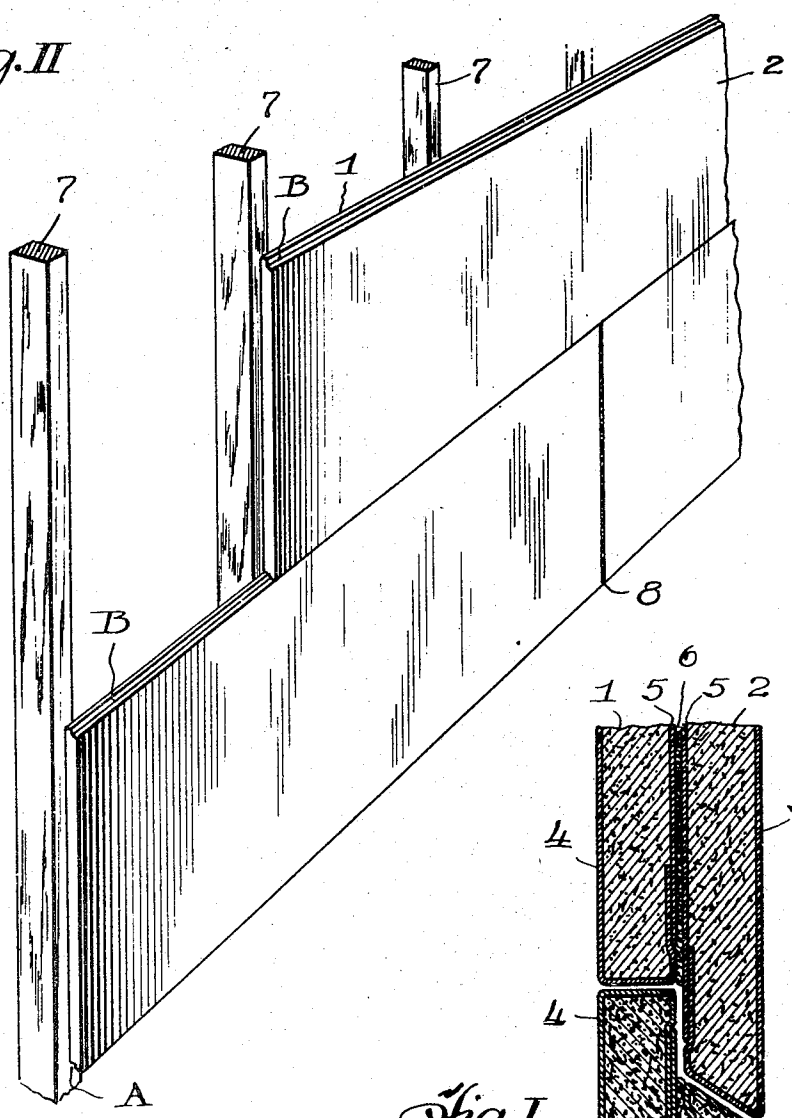
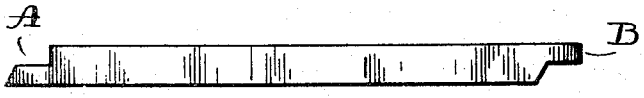


Fig. I

Fig. III



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STRUCTURAL PRODUCT

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1 Claim. (Cl. 154—45.9)

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This invention relates to an improved surfacing material made from laminated sheets of fireproof sheet-like material particularly those formed from calcined gypsum. It particularly relates to a novel method of joining sheets of structural material together to form a proper type of weather barrier with a minimum of effort.

As an outgrowth of the war, a great need has developed for a type of surfacing material which can be quickly and economically erected. A material is required which can be applied by the ordinary workman and will be fireproof. The material must be sufficiently strong to give the required rigidity to the structure and yet light enough to enable large sheets to be used to give ease and speed in application. In order to reduce the cost of such an exterior surfacing material to a minimum this material besides having a weather resistant surfacing must also have a pleasing appearance so that no further decorating is necessary. Also, in order to reduce the cost of erecting, the individual section must be capable of quick and effective joining together with very little treatment of the joints to provide weather resistance, such as by caulking. In addition, the product must resist water satisfactorily to prevent disintegration due to rain and snow and yet be sufficiently pervious to prevent condensation of water taking place either within the board itself or within the wall which it encloses. In other words the material must be sufficiently permeable to water vapor so that it may escape and not be trapped within the interior; but, sufficiently impervious so that water cannot penetrate into the interior of the sheet thereby causing the sheet to deteriorate.

It is, therefore, the purpose of this invention to disclose a product which will ideally meet all the requirements above and which will be well adapted for use as an economical surfacing material on temporary structures.

It was discovered that a material prepared in the manner to be subsequently disclosed, and which is the subject of this invention, was such a material. When the product of this invention was introduced to the building trade, it was quickly applied to many uses.

In carrying out this invention first, it was found that a board of extra thickness was required, such as that obtained by laminating two layers of a fireproof sheet material of conventional thickness, to give sufficient strength and protection. It is preferred to use a material formed from a layer of set calcined gypsum enclosed by two layers of paper and known as gypsum wallboard;

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though other fireproof sheet-like materials could be used.

Second, it was discovered that in order to make a satisfactory joint requiring no caulking, an edge must be used which will permit quick joining of the boards and still be watertight. This is best obtained by joining two sheets together in an offset relationship to form a shiplap type of edge. One of the edges of the sheet, preferably the outside, is beveled so that, in erection, a natural drainage of any water which may have worked its way into the joint will be to the outside.

Third, it was found that, in laminating the sheets together, a glue must be used which is not so resistant to vapor permeability as to prevent the passage of water vapor from the interior to the exterior. Yet it must not disintegrate when immersed in water for a considerable length of time so that there will not be a delamination due to failure of the glue junction.

Fourth, it is important in order to prevent weathering of the exterior surface that a water repellent coating material be applied thereto; though if desired, such treatment can also be applied to the interior surface of the sheet. This coating must decrease water penetration into the interior of the sheet yet still be sufficiently permeable to water vapor so as not to seal moisture within the board or to prevent it from passing from the interior to the exterior surface.

While in carrying out this invention it is essential that all of the above four factors be present, it is also desirable to include certain other elements which will increase the utility of this product. For example, it is desirable to treat the ends of the sheet in order to increase the resistance to weathering and to aid in caulking of the vertical or end joints formed by the abutting sheets whenever such is considered necessary.

Also, in order to dispense with painting after the sheet has been erected, it has been found desirable to use on the outside surfaces of the building unit a paper of pleasing color. For the exposed side, a dark green can be used, and on the interior side a manila or buff color has been found attractive. This use of color on the face side also tends to prevent an error in erecting such as by placing the weather side toward the inside.

The following examples illustrate certain embodiments of this invention. Obviously, other ramifications of the invention will readily occur to those skilled in the art of which this is a part, and still not depart from the spirit or essence of this invention.

This invention is best described by means of drawings. In the drawings:

Figure I illustrates the method of laminating two gypsum boards together in offset relation so as to form a weather resistant, non-caulking, self-draining wallboard joint. The edges are shown spaced apart for purpose of more clearly illustrating the joint. In actual practice the edges will be butted together.

Figure II shows an application of the product of this invention to wood studs for exterior construction.

Figure III is an end view of a building element showing the ends coated with a waterproofing material.

In Figure I, 1 is the interior gypsum board, having square edges and which is laminated in offset relation to the exterior surface board 2 having slanting parallel edges. One of the slanting edges forms an obtuse angle and the other an acute angle with the glued surface forming the interior of the building unit.

In forming the lamination, the interior or square edge board No. 1 is glued in an offset position with respect to the exterior board 2 in such a manner that the acute angle edge of the exterior board 2 extends beyond the right angle edge of the interior board. Hence, the opposite or obtuse angle edge will form a complementary recess extending inward from the square edge since the boards are of substantially the same width. In erection, the obtuse angle edge is placed at the top thus forming a recess for the projecting acute angle lower edge of the above adjacent course as shown in Figure II. Thus a tight, horizontal joint is formed which is self-draining and which requires no caulking. While the above method of offset is preferred, it is possible to have the exterior board receded along the bottom edge and extend beyond the interior board at the upper edge, but the joints in this case will be less weatherproof.

In the manufacture of gypsum board it is preferred to form a folded edge such as by extending the face paper around the edge and forming a lap under the back paper. Thus in Figure I in the square edge interior board 1 the face paper 4 extends around the square edge forming a lap under the back paper 5. By this means a complete sealing of the core is obtained. In the case of the exterior lamina 2, a similar type of lap is formed but the edges are slanting, forming an oblique angle instead of a right angle. In Figure I the face paper 3 after being folded around the oblique edge forms a lap with the back paper 5. The planes of the two slanting edges of the board are substantially parallel.

The exterior surface sheet 3 of the exterior board 2 is preferably colored in order to do away with painting. It has been found that coloring the paper a dark green during its manufacture by dyeing or pigmentation gives a pleasing appearance when the board is erected. A similar treatment can be given the exposed surface sheet 4 of the interior board. A manila or light tan color has been found satisfactory for this purpose. The interior, or glued surfaces, can be of any color, as they will not be exposed. The natural color of the paper is sufficient for this purpose. The back or glued paper on both laminae can be the same as shown here.

The gypsum boards can be of a wide range of thicknesses and still be of value for the purpose. A thickness of ½" for each board has been found the most practical commercially. It supplies ample strength and still is not too heavy so as to impede rapid erection. While a wide range of dimensions of the laminated sections can be used, a width of 18" and a length of 8 ft. is very satisfactory for practical construction. Laminated sections of this size can be expediently handled and still cover a considerable area with each sheet. It is not preferred to use a core of neat gypsum but rather to appreciably lighten its weight with the use of foam or other density-reducing means.

The exact amount of the offset between the edges of the individual boards can also vary within wide limits; however, if too small, there is insufficient protection to the joint so that caulking may be required. If the offset is considerable, an unnecessary greater width of the combined sheet is obtained; also, the glued area will be smaller, thereby decreasing the strength of the section. An adhesive shown as 6 in Figure I is used to adhere the sheets together and will be subsequently described in detail.

In Figure II, 7 are wooden studs to which are attached the laminated building units shown by section in Figures I and III. This figure shows in detail a method of applying the product of this invention. Note that the edge portion which is marked A is placed downward and edge B upward, see also Figure III, thus when these are interlocked together a weathertight, non-caulking, horizontal joint will be made. However, it will be necessary in some cases to caulk the vertical joints formed by the ends of the building units. In Figure II, 8 shows a vertical joint which has been caulked.

In order to protect the surfaces of the paper from rapid deterioration due to weathering, it is necessary to apply a waterproof coating thereto. It has been discovered that a waterproof coating which will not allow the passage of water vapor is only of limited value commercially, as water vapor will be trapped either inside the sheet itself or within the interior of the wall thereby causing rapid deterioration, especially of the board. It is therefore an object of this invention to disclose a surface treatment which will not only give protection from the weather but will also permit moisture vapor to pass through the wall to the exterior surface thus preventing condensation and the consequent loss in strength and insulating value. This type of surface is accomplished; first, by the use of a special type of water-resistant mixture, which when applied to paper has the ability to permit vapor penetration but to resist liquid water penetration; and, second, to cause the water-resistant material to penetrate into the paper in such a manner that no continuous film is noticeable upon the surface of the paper.

While a great number of materials can be used for the water protection treatment, the following formula has given excellent results in actual field trials and is preferred.

	Gallons
Petrolatum dark	2
Paraffin oil, pale	1
Kerosene	1

The ingredients are mixed together at a temperature of approximately 130° F. Electrical heaters or steam coils should be used in order to lessen the danger of fire. For best results the waterproofing material should be warm, about 140 to 150° F., when applied to the board which also should be warmed to about 100 to 140° F.

If the board or waterproofing fluid are too cold, there will be a congealing of the material upon the surface, which will not only result in an unsightly appearance but will furnish too much of an impervious film and decrease or prevent absolutely the passage of water vapor. About 1½ to 2 gallons of the above mixture per 1000 square feet of surface is sufficient. The waterproofing material may also be applied to the edges as well.

Other materials may be used for this surface treatment besides the above formula and still be within the scope of this invention. It is not intended to limit this application to the particular formula given, but broadly to the use of a waterproofing material which upon penetrating into the surface of a fibrous sheet will permit water vapor to pass through and still give protection against passage of liquid moisture.

Another important phase of this application is to use a glue in adhering the two sheets together which will stand up under all ordinary atmospheric conditions. The glue must not soften when subjected to heat as high as 140° F. nor fail when the laminated structure becomes wet. Also, the glue film must not form an impervious layer so as to dam up any water vapor which may migrate from the inside to the outside. While a number of glues may be used for this purpose and while it is not the intention to limit this application to any particular adhesive, the following glue, which is the subject of another application Serial No. 496,074, has given excellent performance:

	Pounds
White K–B paste	10
Emulsified asphalt	5
Water	85
Copper sulfate	0.1

The paste and copper sulfate are dissolved in the water and then the emulsified asphalt. The K–B paste is made by heating steamed corn "grits" in a steam jacketed container for one hour using 60–100 lbs. steam pressure in the steam jacket followed by flaking between hot rolls and breaking up into a powder.

The following is an approximate composition of the K–B paste prepared in this manner:

	Per cent
Water	4.1 to 5.6
Ash	0.3 to 0.4
Crude protein	9.0
Fat	0.7
Crude fiber	0.4 to 0.5
Water soluble matter	20.1 to 26.0
Insoluble starch	56.6 to 54.0
Water soluble starch and dextrose calculated as starch	18.3 to 23.7
Reducing sugars	0.12 to 0.15
Non-reducing sugars calculated as sucrose	0.26 to 0.35

The emulsified asphalt preferably is a fine emulsion of asphalt in water using bentonite as the emulsifying agent to give a heavy pouring consistency. Other emulsified asphalts can be used with a slight variation in the formula. An asphalt emulsion made by the Flintkote Company known as N13HPC has been found to be very satisfactory under practical conditions.

The copper sulfate is used for the purpose of preserving the paste from fungus attacks. Other fungicides could be used if desired.

In order to protect the exposed ends of the boards, that is, those ends not enveloped in vapor during board manufacture, it is desirable to

apply a waterproof material thereto. The following formulation, which has been found very satisfactory under practical application, is applied to the ends preferably after the gypsum boards have been removed from the kiln and while the boards are stacked on pallets.

	Pounds
Petrolatum dark	2
Paraffin oil pale	2
Crude scale wax or paraffin	4
Candelilla wax, crude	1

The above materials are melted together followed by mixing. About 20 to 50 pounds of this composition per 100 square feet of end surface have been found sufficient. The wax mixture should be applied while hot, preferably between 160 to 180° F. Care should be exercised to be sure that there is good penetration, which can best be done by "flaming in," i. e., by applying a flame for a short length of time to the surface causing the composition to penetrate into the core. Other equivalent waterproofing materials may be used for the purpose. An end treatment of this nature will, in a great many cases, do away with the need for caulking of the vertical joints.

While a combination of a specific glue, waterproofing composition and method of forming the edges of the laminated roofing element is given in the above examples, this is done solely for the purpose of clearly pointing out a preferred means by which this invention may be carried out. Obviously, other combinations of adhesive, waterproofing composition and edges can be used and still be within the scope of the invention. Various types of self-draining, non-caulking joints can be combined with waterproofing agents such as the resinous, either natural or artificial, type. More than two laminae can be used with very beneficial results and the edges of more than one sheet may be slanted.

Sheets of building materials, particularly those made from calcined gypsum surrounded by an enclosing paper, laminated and waterproofed in the manner described in detail above, have outstanding value in the quick construction of temporary building at very low cost. The large size sheets of 2 x 8 ft. cover 16 square feet at a time when erected, yet they are not so heavy that they cannot be conveniently handled by workmen at reasonably fast speed. When erected, no further exterior treatment is needed except for caulking of the vertical joints whenever it is considered necessary. Since this siding material can be colored during manufacture and waterproofed, its surface need not be further decorated or treated when erected. Because of its strength, especially when two ½" sheets are laminated together, no further bracing or siding material is needed. These outstanding advantages in erection, economy, and weather resistance, coupled with the inherent fireproofness of a gypsum slab, have resulted in the product of this invention being widely used in the erection of temporary structures needed as a result of the war, such as for example in war housing projects, barracks, warehouses, temporary manufacturing plants, hangars and hospitals. It can also be used for such purposes as farm or resort building or the temporary buildings erected in the construction of various projects such as dams, bridges, skyscrapers, etc. Material made practicing this invention will have surprising resistance to weathering due to exterior exposure to sleet, snow, rain, sun rays, high humidity and sudden atmospheric changes.

It is possible, but not preferred, to erect the building units vertically in such a manner that the weather sealing joint is vertical and over a stud. In such case the sheet should be sufficiently long so as to extend from the eaves to the ground thus doing away with a horizontal and unprotected joint. Also, the product of this invention can be used as a roof for temporary construction, in which case it will probably be found desirable, especially in the case of fairly level roofs, to apply additional protection such as rolled roofing over the exposed surface to prevent the possibility of leaks.

By way of summary, this invention consists preferably of (1) the lamination of at least two layers of a sheet-like building material, such as a gypsum core surrounded by enclosing paper liners, in offset edge relation; (2) the edges of at least the exterior lamina slanting so as to give exterior self-draining to the horizontal joint of two vertically adjacent sheets; (3) a waterproofing treatment applied to the exterior surface of the element which along with (4) the laminating glue is not only resistant to disintegration due to moisture but is also permeable to water vapor, resulting in a siding element not only very resistant to weathering but also economical and quick to erect. In addition it is preferred to use an end waterproofing treatment of the sheet to prevent weathering and to decrease the necessity of caulking. It is also preferred to use a colored, decorative paper to give pleasing surface appearance to the element when in place without requiring painting after erection to accomplish this.

Having disclosed a practical embodiment of this invention and specific examples and uses which are given to insure a clear understanding of the essence of this invention, it is not the intention to be limited thereby for, obviously, many variations may be made by those skilled in the art and still be within the scope of this invention which is only limited in extent by the forthcoming claim.

It is claimed:

A laminated sheet-like building element comprising an exterior wallboard and an interior wallboard adhesively bound to each other in an offset relation, said adhesive having the property of resisting bond failure due to soaking in water but pervious to water vapor, said exterior wallboard having declining slanting opposite edges in substantially parallel planes, a water-repellent surface coating permeable to water vapor upon the exposed surface of said exterior board.

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