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REENFORCED INSULATING ROOF SLAB

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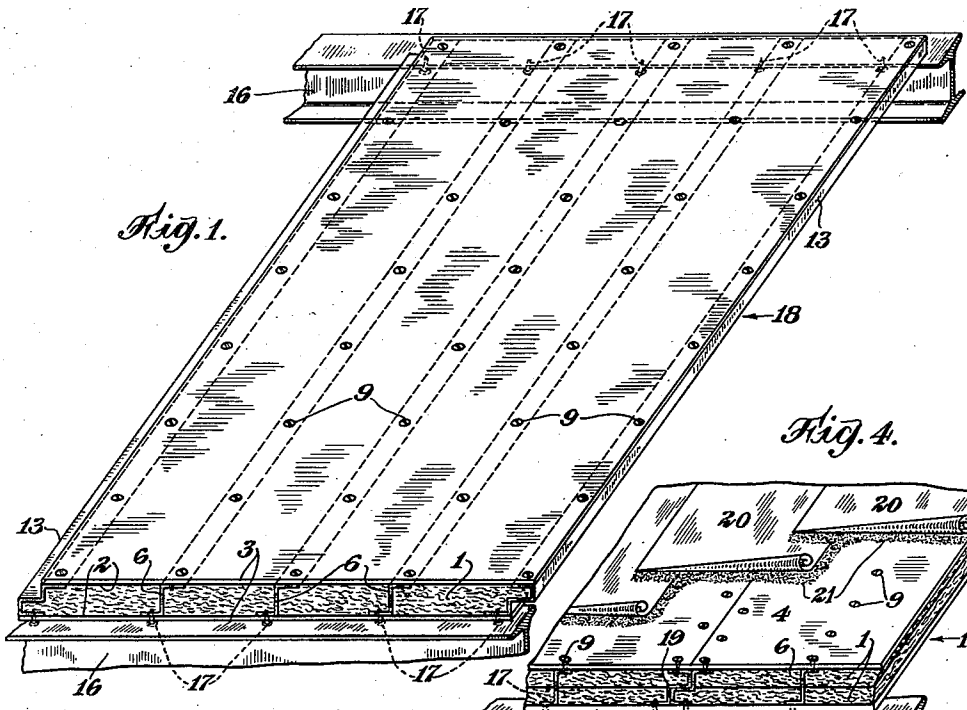
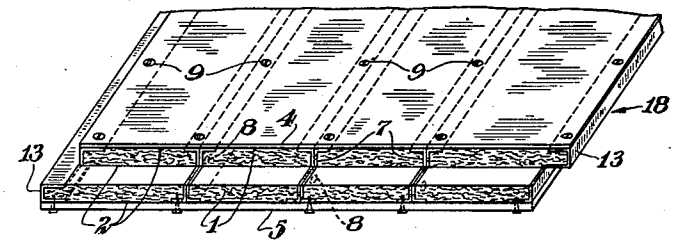


Fig. 1.

Fig. 4.

Fig. 2.



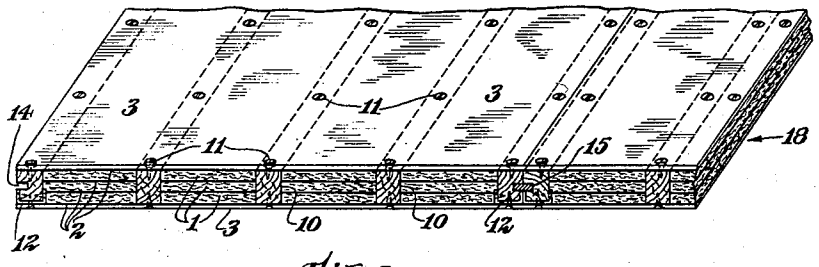


Fig. 3.

INVENTOR
Charles J. Beckwith.
BY D. N. Halstead
ATTORNEY

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REENFORCED INSULATING ROOF SLAB

Charles J. Beckwith, Brooklyn, N. Y., assignor to Johns-Manville Corporation, New York, N. Y., a corporation of New York

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7 Claims. (Cl. 108—1)

This invention relates to a reenforced insulating roof slab or panel. The invention relates especially to a reenforced unit comprising an insulating core, units of facing material on each side of the insulating core, and inwardly disposed reenforcing ribs or members.

A panel for use, say, in the roof of a factory building should be non-corrodible, adapted to carry a substantial load, resistant to breaking by shock, and should be provided with an exterior that is non-porous or impervious and, for some purposes, should be adapted to be washed, to be polished, to present a pleasing appearance without decoration, and/or to preserve this pleasing appearance on long exposure to the atmosphere. For some purposes, the panel should be fireproof and thermal insulating.

An object of the present invention is to provide a structural unit or panel that meets the above requirements. Other objects and advantages will appear as the description of the invention progresses.

A preferred embodiment of the invention is illustrated in the drawing in which

Fig. 1 shows a perspective view of an insulating panel in which the inwardly disposed reenforcing members or ribs are continuous bars of a modified Z-shape.

Fig. 2 shows a perspective view of an embodiment of the invention in which the panel has a greater thickness of facing material on the side that is to be under tension than on the other side that is to be compressed when the panel is loaded during use. The reenforcing members may be small I-beams and the panels may have not only side but also end edges provided with ship-lap construction.

Fig. 3 shows a perspective view in which wooden strips are used as the reenforcing members. This figure shows also a method of assembling two panels at their side edges.

Fig. 4 shows a perspective view of an assembly adapted for use as a roof. This figure shows also the preferred method of assembling the panels at their side edges, namely, in a ship-lap joint.

In the various figures, like reference characters denote like parts. Thus, 1 is an insulating core or inwardly disposed insulating member. It may consist of one or more plies or layers of insulating material. If more than one layer is used, the various layers are advantageously adhered to each other, as, for example, by means of a continuous film of casein or other suitable adhesive 2. The insulating material is suitably in preformed semi-rigid form, such as cane fiber board or wood fiber board, that is light in weight and effective in thermal insulation. Compositions comprising asbestos fibers or mineral wool may also be used. Thus, there may be used such compositions in which the fibers are bonded into semi-rigid slabs or blocks by means of a binder, such as starch or asphalt. When the insulating core is semi-rigid, it serves to brace and thereby strengthen the assembled panel. If this function is not desired in the panel, loose felting material, such as fibers that are not bonded together, may be used as the insulating core.

The facing material 3, 4, or 5 is juxtaposed on each side of the insulating core and is adhered thereto by the adhesive 2. A facing material that is preferred at this time is an asbestos and Portland cement sheet that is in wide use commercially. Such sheet material may be made by mixing approximately one part by weight of asbestos fibers with one of Portland cement and water, to form a sludge, forming the mixed materials into a layer that is relatively thin in proportion to its length and breadth, highly compressing the layer to densify it and to expel excess water, and allowing the sheet thus formed to harden. Such a product is rigid, in the sense that the term is used herein, that is, substantially rigid although resiliently yieldable under heavy loading of sheets of common commercial thicknesses, strong, stonelike, incombustible, and non-porous to the extent that water does not pass through it readily, although the sheet may absorb some moisture from a humid atmosphere, is non-corrodible, and may be polished and washed, with the production of a pleasing surface that does not undergo substantial change on exposure to air. Other facing materials, having as many of the properties of the asbestos and cement board as may be desired in a panel for a given use, may be used. However, the asbestos and cement board is preferred at this time, not only because of the properties given, but also because strong, rigid sheets of such board may be had in thicknesses that are not excessive from the standpoint of weight in a building structure, and at a cost that is satisfactory.

It will be understood that, in the structure shown in Fig. 1, the facing members are spaced and fixed approximately but not exactly in preestablished position with respect to each other. When a load is applied to a face of such a unit, to give flexing, there arises compression of the facing member to which the load is applied and tension of the opposite facing member.

The facing material may have different thick-

nesses on the two sides of the panel. Thus the layer of facing material 4 that is to be the upper side in a roof and that is to be under compression when the roof is loaded, may be thinner than the facing material 5 on the opposite side which is under tension when the roof is loaded. This is especially desirable when the facing material used is one that has a substantially greater compression than tensile strength, as is the case with asbestos and Portland cement boards. Since such boards have sometimes ten times as great compression as tensile strength, it will be evident that much different thicknesses may be used on the two sides of the panel, if it is desired that the facing material on the two sides should fail under about the same load. Thus the facing material that is to be under tension may be substantially thicker, say, two to five or ten times as thick as the other layer of facing material. However, the upper layer of facing material, say, in a roof structure, should not be so thin as to permit its being punched through or broken by a concentrated load.

The reenforcing bars are in spaced relationship to each other and may extend lengthwise or crosswise in the panel. The lengthwise arrangement illustrated is preferred at this time.

These reenforcing bars or members may be constructed of steel or other rigid, non-brittle metal and may have a modified Z-shape, as illustrated at 6, or other suitable shape, such as that of a small I-beam 7 suitably formed by spot-welding together the backs of channel irons at intervals, as at 8. As illustrated, the web member of these reenforcing bars extends through the insulating core, between the inside surfaces of the units of facing material. Flanges on the web member extend parallel with the said inside surfaces and in contact with those surfaces, to provide a beam effect that minimizes danger of breakage of the facing material, when under load, in the areas adjacent to the reenforcing members and to provide for securing the bars conveniently to the facing units.

The bars or reenforcing members are secured to the facing material, suitably mechanically, as by case-hardened, self-tapping screws 9 passing through preformed holes in the facing material at intervals and through flanges of the reenforcing members, to increase the rigidity of the structure.

In the modification shown in Fig. 3 the reenforcing members or bars 10 consist of a more resilient material such as wood. Such members are adapted to be flexed substantially without breaking and to return to their original position, to a larger extent than is the case when the reenforcing members are of the metal type illustrated in the other figures. It should be understood, however, that the steel members, for example, are also somewhat springy or resilient, that is, are adapted to be flexed to a certain extent without being permanently deformed to the full extent of the temporary flexure.

The wooden reenforcing strips may be secured to the facing material by means of wood screws 11. Further, the wooden strips may be seated at one or both of their outer edges in channel irons or other supporting members 12. In this case, the securing means or screws 11 may pass through the facing material and the supporting means and into the wood.

The edges of a panel, suitably on at least two opposite edges, may be closed by reenforcing strips 13. These serve to face the insulating core at its edges and thereby protect the edge of the insulating core and to reenforce the panel. Further, these edge-closing strips may take the ship-lap form shown at 19, which adapts the panels to be assembled as illustrated in Fig. 4. Or the edge strips may be provided with a notch 14, corresponding to a similar notch or groove in another sheet, and adapted to enclose therewith a spline member 15. The spline member may be of the same material as the edge strip. Thus, if the edge strip is wood, the spline member may also be of wood, such as hardwood.

The insulating core as indicated may be of one or more thicknesses of insulating material. One thickness only is shown in Fig. 1. Two thicknesses joined along the cement layers 2 are illustrated in Fig. 2. Three thicknesses joined along the cement layers 2 are illustrated in Fig. 3.

In the roof assembly shown in Fig. 4, only a purlin 16 of the supporting substructure is given. The purlin extends transversely to the length of the panels and permits the abutment of ends of panels in a line over the face of the purlin. Adjacent panels abut at their side edges along the ship-lap joint 19, for example. It will be understood that there may be employed any conventional substructure suitable for supporting large panels of building material of the weight and size that are to be used. The purlin 16 is suitably attached, as by screws 17, to panels 18 of the type of the present invention. The screws or other suitable fasteners secure the purlin to the reenforcing members at both ends of the panel, as shown in Fig. 1. A man on the roof, for example, is supported by the steel reenforcing members and is thus kept from falling through, even though the panel cracks on one or more of its faces. The assembly of panels is covered with a conventional roofing exterior, as, for example, by a built-up roofing comprising roofing paper 20, suitably in a plurality of layers, such as three or more, adhered to the upper surface of the panels and to each other by means of adhesive layers 21, composed suitably of an asphalt mopping of usual composition, applied in a usual manner. The built-up roofing serves not only to prevent access of water to the underlying panels but also provides some shock absorption and distribution of concentrated loads, thereby reducing somewhat the danger of breakage of the thin facing unit 4 by shock or by sharply localized overloading.

Panels of the construction described may be made of various dimensions. Thus there has been made a panel 4 by 8 feet with an insulating core of 1 inch insulating lumber, Z-bar reenforcing members extending lengthwise of the sheet, the Z-bars having ⅞ inch web and ¾ inch flanges and being spaced on 12 inch centers. The asbestos and cement boards, constituting the facing members on either side, were ¼ inch thick. These were attached to the reenforcing members by flat head machine screws on 12 inch centers. Also, the facing sheets were adhesively secured to the two faces of the insulating core by means of a casein adhesive. The reenforcing members and insulating core extended continuously between the inside surfaces of the facing sheets.

This panel had an over-all thickness of 1.48 inches and weighed 7.2 pounds per square foot. When submitted to test, the panel showed surprising properties. Supported by beams at positions 7 feet apart and subjected to concentrated loading, the 7 foot span failed by cracking of the lower unit of facing material, at 1,665

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pounds total load. The maximum deflection at break was 0.85 inches. When the load was removed from the sheet that had failed, the panel returned partly to its original position, so that the maximum permanent deflection was 0.48 inches.

Similar tests were made on a panel in which the reenforcing members were wood strips of cross section 1.1 by 1.4 inches, the facing material on each side was asbestos and Portland cement boards 0.175 inches thick, and the thermal insulating core consisted of three adhesively secured plies of ½ inch insulating lumber. The over-all thickness was 1.82 inches and the weight per square foot 6.8 pounds. The breaking load for a 7 foot span of this panel was found to be 1,665 pounds also. The maximum deflection at break was 0.87 inches and the maximum permanent deflection, after removing the load from the broken panel, was only 0.26 inches.

The advantages of structural insulating panels that will withstand such loads and yet will be deflected so little, even on breaking, are obvious.

The panels have other advantages in addition to those that have been mentioned. The composited panel is less rigid than a sheet of equal thickness composed solely of the facing material. When the composited panel is flexed there is less stretching of the face that is under tension, for a given amount of flexure, than when the panel is constructed throughout of solid, rigid material of the type used as the facing of the composite.

The panels are light in weight in proportion to their strength. They can be installed in a structure easily and may be supported in long spans. The thermal insulating properties of the panel have been mentioned. In this connection it should be observed that the reenforcing members may have low heat conducting capacity. If the reenforcing members are wood, the specific thermal conductance is low as compared to the specific conductance of a metal. Furthermore, when the reenforcing members are composed of material that is high in specific thermal conductance, say of steel, the area of cross section of such members may be so small that the actual heat-carrying capacity is low. Furthermore, the facing material of the preferred composition is not such as to transmit heat very readily to the reenforcing members. For example, the specific thermal conductance of asbestos and Portland cement sheets is low as compared to that of sheet steel. If the facing material were constructed of metal, such as steel, and the metal facing were directly in contact with metal reenforcing ribs extending from one side to the other, there would be substantial capacity for transference of heat along the facing material to the ribs and then through the ribs to the opposite side of the panel.

Since many variations from the illustrative details that have been given may be made without departing from the scope of the invention, it is intended that the invention should be limited only by the terms of the claims.

What I claim is:

1. A panel comprising an inwardly disposed thermal insulating member, stone-like facing units juxtaposed on each side of the insulating member, and spaced reenforcing bars extending between the inside surfaces of the facing units, the insulating member and also the reenforcing bars being secured to the facing units.

2. A panel comprising an inwardly disposed thermal insulating member, non-porous, rigid, non-corrodible, fireproof facing units juxtaposed on each side of the insulating member, spaced reenforcing bars extending between the inside surfaces of the facing units, and ship-lap reenforcement closing at least two opposite edges of the panel.

3. In a thermal insulating structural unit, of large load carrying capacity, comprising an insulating core and rigid facing material of greater compression than tensile strength adhered to both faces of the core, the improvement comprising facing material of substantially greater thickness on the face of the unit that is to be under tension than on the side that is to be compressed under load.

4. In a thermal insulating structural unit, of large load carrying capacity, comprising an insulating core and rigid facing material of greater compression than tensile strength adhered to both faces of the core, the improvement comprising facing material of thickness at least twice as great on the face of the unit that is to be under tension as on the side that is to be compressed under load.

5. A thermal insulating, water-tight, fire-resistant roof assembly adapted to carry a substantial load, said assembly comprising a supporting substructure, panels, of the kind described in claim 3 and containing as the facing material preformed sheets of compressed and hardened composition of asbestos and Portland cement, supported by the substructure, and built-up roofing overlying the said panels, the said roofing preventing the entrance of moisture into the assembly and also minimizing the danger of localized overloading of the facing material adjacent thereto.

6. A structural unit, adapted to support a substantial load applied to a face thereof, comprising a core material and strong facing members of like material, of greater strength under compression than under tension, disposed over and adjacent to the opposite faces of the said material and fixed in approximately preestablished position with respect to each other, the facing member that is to be under tension being of substantially greater thickness than the facing member that is to be under compression when the unit is loaded.

7. A structural assembly including a supporting substructure, panels, supported at opposite ends on the substructure, comprising a preformed insulating core, rigid facing units disposed on each side of the insulating core, and inwardly disposed reenforcing members, and means securing the said reenforcing members to the substructure at both ends of the panels, the said core and reenforcing members extending continuously between the inside of the said facing units and the core being adapted to provide bracing for the said panels.

CHARLES J. BECKWITH.

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