A. E. GESSLER ET AL
2,562,711

METHOD OF PRODUCING HEAT AND SOUND INSULATION
Filed Feb. 25, 1948

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

Fig. 5.

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METHOD OF PRODUCING HEAT AND SOUND INSULATION


Application February 25, 1948, Serial No. 10,894

2 Claims. (Cl. 154—110)

1. This invention relates to materials useful in sound and heat insulation and the process of making them. The materials are applicable to structures of various sorts, particularly moving vehicles such as automobiles and airplanes, and it aims to provide a sound and heat insulating unit characterized by optimum insulating value combined with ease of installation and surface characteristics, which include pleasing appearance, with ease of cleaning and general maintenance. Specifically, our new insulating unit comprises a laminate of a relatively thin film (measured in thousands of inches) of a plastic foil, and a relatively thick backing (measured in inches) of certain insulating materials herein-after described, the foil being perforated over a certain percentage of its area.

In present day insulating practice, a fibrous material is generally used for heat insulation, such as stiff bagasse board (Celotex), or more loosely felted boards or flexible felts of fibers, or even loose bats or rock wool, glass wool or other fibers. These materials absorb both heat and sound; but they present surfaces which attract dirt, and cannot be cleaned readily. Hence, they are generally covered in practice with some decorative material. Where noise elimination is desired in addition to heat insulation, this decoration has always sharply reduced the sound deadening effect of the fibrous insulating material.

A general expedient has been adopted do provide for decoration without too great a loss of sound deadening. One has been to cover a relatively loose fibrous insulation with a woven fabric, which may be of relatively open structure, or may even have holes cut in the fabric. This expedient has the drawbacks that the fabric, while less difficult to clean than the backing, must be removed to effectively clean it; the decorative effects are somewhat limited; and the unit resulting from the combination has not structural strength. The other expedient is the familiar bagasse board with holes punched down into the board, with the top surface painted; such units have structural strength, and can be cleaned, but are rather expensive, have relatively less sound-absorbing efficiency than the loose fibrous materials, and tend to plug up when repainted, due to the fact that the holes must be of small diameter if a washable decoration is to be obtained.

We have produced an effective sound and heat insulating unit, characterized by having sound and heat insulating characteristics approaching those of undecorated, relatively loose fibrous masses, combined with a decorated washable surf-
into the acoustic board. In such construction the board absorbs the sound sufficiently so that the re-echoing obtained in the space above the composite sheet is not required.

For very absorbent material (e.g., the very loose "Insullite" board, or loose rock wool) the hole $27$ is drilled only through the outer layer, since the sound absorbent material permits the sound to travel into it, and absorbs it by innumerable holes throughout the mass. In this case, the outer layer of foil may be laminated to a board, or may be a separate laminated structure sufficiently rigid to support the rock wool. A typical construction may be prepared as follows:

A five mill cellulose acetate sheet, matte finished on one side, is decorated on the clear or under side, by printing with suitable lacquer inks. Over the printed design there is usually coated a solid base or background color, also of a lacquer-type material. Against this lacquered coat there is now laminated a high bulk, 70 lb. paper stock. The cement used for this operation is a lacquer-type thermoplastic film, which can be applied either by spray or coating, the greater portion of the solvent evaporated, and the paper applied thereto by heated rolls.

This decorated laminate product is now ready to be cemented to, and molded with, a backing of "Celotex" board, preferably $\frac{3}{8}$" to $\frac{1}{4}$" in thickness. This is carried out simultaneously as follows: The "Celotex" board is first humidified in a suitable moisture cabinet in order to bring it to a pliable condition. A urea-formaldehyde water syrup adhesive, such as is commonly used in the production of plywood, is coated on both the "Celotex" and the paper side of the laminated sheet. The two are brought together, allowing an overlap of the sheet, which can be clamped at the two ends of the mold, preparatory to forming. The mold is heated to approximately 270°F. and applied with sufficient pressure to deform the sheet and the "Celotex" board to conform to the shape of the mold. The purpose of the elevated temperature of the mold is twofold. First, to warm the acetate sheet sufficiently to permit the flow or formation to the desired shape. Secondly, to convert or "kick over" the urea cement to form a permanent moisture-resistant bond between the foil and the "Celotex" board. The mold is now rapidly chilled by circulating a cooling medium through the mold structure. The mold can then be opened and the finished product, which is now permanently molded, removed.

In place of the "Celotex" board, cited in the above example, we have also found it practical to use "Fibrolite" board, made of wood fibers, of excelsior-like formation, loosely bonded, with high insulating values for both acoustics and heat. In places where the desired shape requires the highest degree of moldability, not within practical range of the board and a backing, formed of moldable layers of two-way stretch creped paper in place of the "Fibrolite."

In order to give any of these products the maximum acoustical damping effect, it is desirable to have holes through the acetate sheet to permit the sound waves to enter and to be absorbed in the mass of the backing material.

Where the mass of this backing material is comparatively dense, as in "Celotex," the holes should be drilled well into, or through the entire body of the board in order to permit the sound waves to enter the pores of the backing material throughout its entire thickness as shown in Figs. 4 and 5. In the case of the highly porous "Fibrolite," it is sufficient that the holes merely penetrate the laminated sheet as shown in Fig. 4, since they will then be readily absorbed into the backing material.

In all of the above cases cited, the insulating backing material is rigid enough in its molded form to be mounted in the car with end supports only.

We have a second type of insulating material, such as rock wool batts, which is not rigid or self-supporting across the arc of the top of the car. In this case it is necessary to supply sufficient rigidity in the decorated sheet, which is not obtained with the single paper backing above described. In this case, to obtain a semi-rigid molded structure, it is necessary to add back laminating material, consisting of a multiple number of paper sheets, cardboard, strawboard, felt, linen or base, impregnated cloth, etc., usually resulting in a mass about $\frac{1}{2}$" thick. The above backing materials may be impregnated with converting resins, which are set in the molding operation to obtain still greater rigidity. This material, in itself, is not sufficiently rigid to be supported on the edges only, but must have some additional support from the ceiling beams at the joints or seams where the sections meet, the car being lined with a number of molded panels. These sheets, after lamination, are perforated to permit the sound waves to pass through. After molding, there is applied thereto an insulating material, such as batt or pad of rock wool, which will fill all, or practically all, the space between the molded material and the ceiling of the car, thus aiding in damping the vibration of the top.

Obviously, many modifications can be made in our invention without departing from the spirit thereof, as defined in the claims.

For so much as is common to this application and our Patent No. 2,455,926, issued December 14, 1948, we claim the benefit of priority of that patent.

We claim:

1. The method which comprises providing a relatively thick board having inherently heat and sound absorbent quantities and being susceptible to softening by moisture, in a humidified and softened condition, applying to one surface each of the board and of a sheet of water-resistant, flexible foil, an adhesive, simultaneously cementing the board and the foil and molding the assembly to the desired shape and thereafter drilling holes at least through the foil to the board.

2. In a method of providing a pre-shaped heat and sound absorbent board with a water resistant foil surface, the method which comprises providing a relatively thick board having heat and sound absorbent qualities and being susceptible to softening by moisture, in a humidified and softened condition, applying to at least one surface of the board and a sheet of water-resistant, flexible foil to be joined, a thermosetting adhesive, simultaneously cementing the board and the foil and molding the assembly to the desired shape by means of heat and pressure and thereafter drilling holes at least through the foil to the board.

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