Sept. 15, 1925 1,554,180

W. S. TRADER

SOUND ABSORBING BOARD FOR WALLS AND CEILINGS

Filed Oct. 10, 1924 2 Sheets-Sheet 1

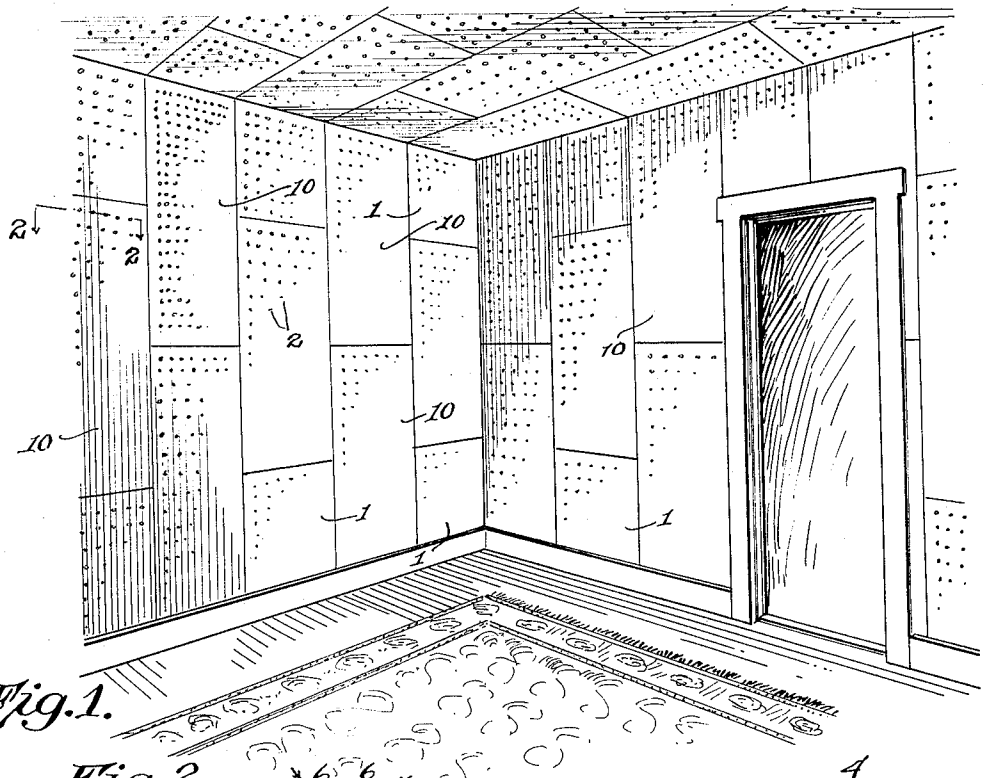

Fig. 1.

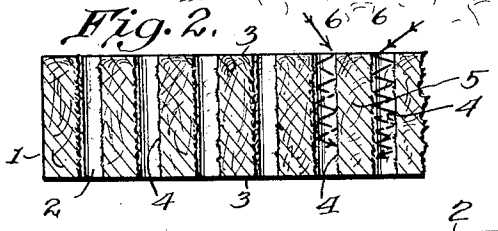

Fig. 2.

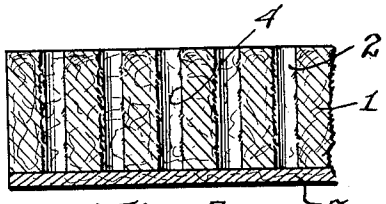

Fig. 3

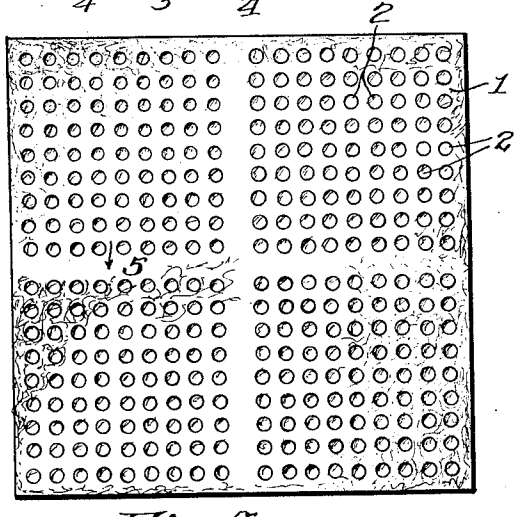

Fig. 5.

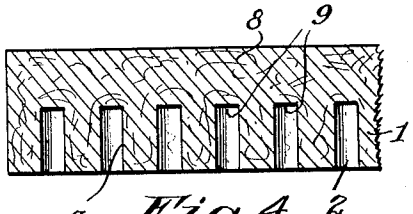

Fig. 4.

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SOUND ABSORBING BOARD FOR WALLS AND CEILINGS

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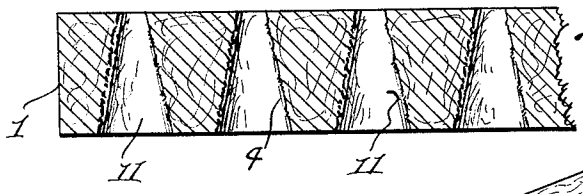
Fig. 6.



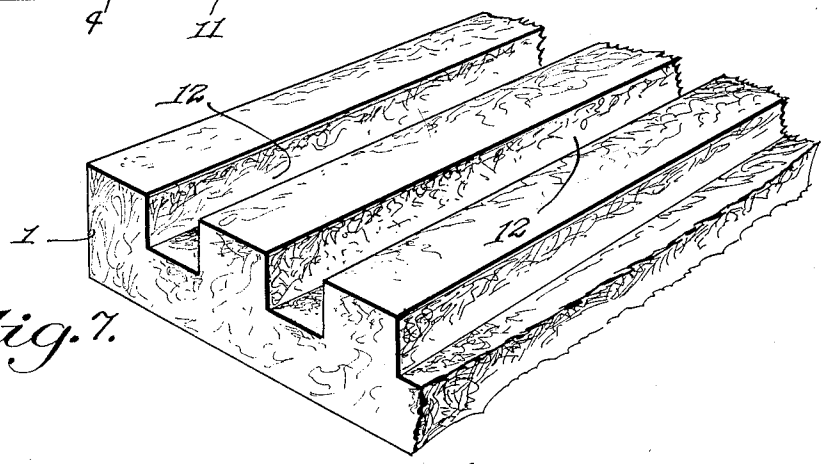


Fig. 7.

Fig. 8.

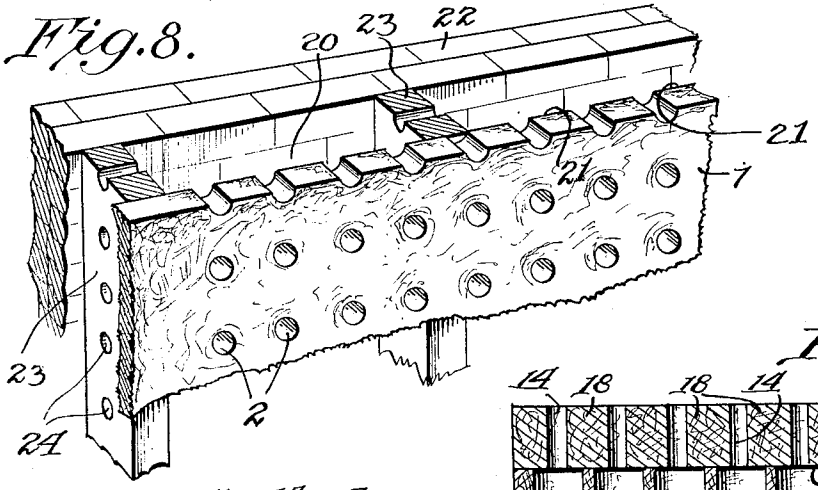
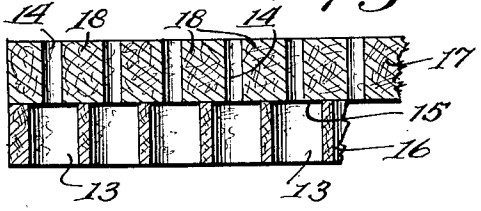


Fig. 10.



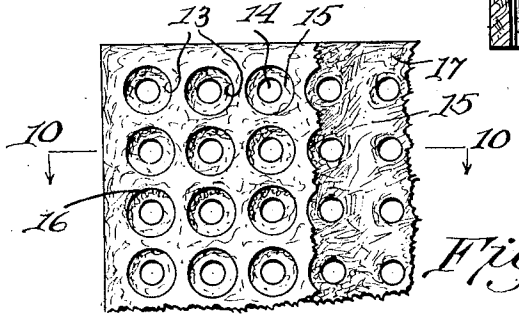


Fig. 9.

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Patented Sept. 15, 1925. 1,554,180

UNITED STATES PATENT OFFICE.

WILBUR S. TRADER, OF ST. LOUIS, MISSOURI, ASSIGNOR TO DAHLBERG & COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF DELAWARE.

SOUND-ABSORBING BOARD FOR WALLS AND CEILINGS.

Application filed October 10, 1924. Serial No. 742,777.

To all whom it may concern:

Be it known that I, WILBUR S. TRADER, a citizen of the United States, residing at St. Louis, in the county of St. Louis City and State of Missouri, have invented certain new and useful Improvements in Sound-Absorbing Boards for Walls and Ceilings; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to sound absorbing boards or material, and has for its object to provide an article of manufacture that will be simple in construction and for the same absorbing capacity will be less costly to make than those heretofore proposed.

With these and other objects in view, the invention consists in the novel parts and combinations of parts constituting my improved sound absorbing board, all as will be more fully hereinafter disclosed and particularly pointed out in the claims.

Referring to the accompanying drawings forming a part of this specification, in which like numerals designate like parts in all the views:—

Figure 1 is a diagrammatic perspective view of a room or enclosure lined with my improved sound absorbing board;

Figure 2 is a diagrammatic cross sectional view of a "Celotex" or "Insulite" board showing perforations extending entirely through the board;

Figure 3 is a modified view of a perforated board showing an additional member for covering the perforations on one side of the said board;

Figure 4 is a modified view similar to Fig. 3, wherein the perforations are not carried entirely through the board;

Figure 5 is a plan view of a "Celotex" or "Insulite" board showing one pattern in which the perforations may be arranged;

Figure 6 shows a further modified form of perforations;

Figure 7 shows a still further modified form of "Celotex" or "Insulite" board having channels instead of perforations to enhance the sound absorbing qualities;

Figure 8 illustrates a perforated "Celotex" or "Insulite" board spaced from a supporting wall;

Figure 9 is a plan view of a board partially broken away and provided with perforations of different diameters; and

Figure 10 is a sectional view taken on the line 10—10 of Fig. 9.

In order that the precise invention may be the more clearly understood, it is said: It is now well known that objectionable acoustic conditions exist in buildings, rooms and enclosures largely due to the fact that when a collection of waves constituting a sound is emitted, said collection or train of waves will not only go directly to the ears of the hearer, but will be reflected by the adjacent walls or surrounding objects back to the said ears of the hearer, and often reach said ears simultaneously with a second collection of waves emitted from the same source and constituting a different sound. As the ear has to distinguish between these two sounds, it finds itself in the position of having heard the first sound due to the direct transmission to it of the first collection of waves, and of having heard the second sound mixed with more or less of the first sound, due to the direct transmission to said ear of the second collection of waves and the simultaneous reflected transmission to it of the said first collection of waves.

In other words, in an ordinary room, the reflections of previously generated sound waves are constantly reaching the ears of the listeners at the same instant with later generated sound waves, causing more or less confusion, nervous strains and bad acoustic conditions, all of which could be avoided if the various collections or trains of waves were wholly or even partially prevented from being reflected back to the listener.

Heretofore, very many substances having sound absorbing qualities have been used in enclosures of various kinds to accomplish this result, and among them probably hair felt is the most efficient. But it is further well known that all of these substances are expensive and that they offer to architects and users very many objections in practice. Some of these objections are found in the difficulty of satisfactorily securing the ma-

terial in place, the unsightliness of the material when in place, and the uncertainty as to whether or not a given amount of the material will absorb a sufficient amount of the waves to produce the desired calm, quiet or freedom from objectionable noises in the room.

It is further recognized that the most effective way to prevent sound waves from being reflected back to the hearer is to absorb or use up the energy of said waves, and that the reason that hair felt shows such a high efficiency as compared to other substances in the absorption of sound, is due to its porous nature and the heat consuming friction generated on its interior by the sound waves traversing its fibrous mass.

It is further well known that there is now in extensive use throughout the country a building or a wall board known as "Celotex" which consists of a felted mass of strong bagasse fibers so compacted as to be capable of use as an artificial lumber, in that in can be sawed and nailed, and has sufficient strength in many cases to be substituted for lumber. There is also in extensive practical use another building or wall board known on the market as "Insulite", which is made from wood pulp tailings, and which likewise has a porous fibrous body portion, and is possessed of considerable strength when nailed to the walls of houses. Both of these boards "Celotex" and "Insulite", are ornamental for many building purposes without further treatment, and can be readily colored or treated to take on an ornamental appearance under any conditions. Therefore, neither of them involve the objections that are inherent in other sound absorbing materials when used as a lining for the walls of inclosures, and each of them can be readily cut to given dimensions and nailed in place by unskilled labor with the same facility as can lumber. Each of these boards "Celotex" and "Insulite" have very high heat insulating qualities, due to the fact that their compressed fibrous masses provide numerous interstices or air cells, and therefore they are each extensively used for their heat insulating properties as linings for buildings, etc.

The sound absorbing qualities of both "Celotex" and "Insulite" is fairly good without perforations due to their porous natures, but each of these materials are made from wet pulp, and when dried have surfaces whose pores or interstices are more or less closed due to the presence thereon of films or skins caused by the pressure to which the pulp is subjected during the process of squeezing out the surplus water, and due to the more or less cementitious or adhering qualities of the finished fibers. It thus results that these surface films or skins are sure to prevent the sound waves from freely entering into the interstices of the fibrous mass, and to reflect back more or less of the objectionable sounds, in spite of the presence of the highly porous interiors possessed by both Celotex and Insulite boards.

According to this invention on the other hand, I have discovered that by perforating a Celotex or an Insulite board 1, and carrying the perforations 2, entirely through the board the reflecting and relatively smooth surface 3 is partially destroyed and the relatively ragged and porous surfaces 4 of the perforations 2 are exposed to the sound waves. The ragged irregular interstices with which the raw surfaces 4 are provided communicate directly with the open interstices or air cells with which the interior of the Celotex and Insulite boards are provided, and therefore the sound waves readily pass from the walls 4 of the perforations 2 into the interior spaces 5 of the fibrous boards where they penetrate the tangled masses of fibers and strike against the individual fibers in such a manner as to render impossible their reflection back into the room, all as is roughly indicated by the lines 6, Fig. 2. This penetration of the porous fibrous masses and striking against the individual fibers just mentioned, further gives rise to more or less resistance to the sound waves, and the resulting friction consumes a material proportion of their energy, which actions would either not occur at all, or at most would be slight if the perforations 2 and raw surfaces 4 did not exist.

As a result of perforating boards made from individual vegetable fibers such as Celotex and Insulite, I have found by actual tests that their sound absorbing qualities are at once raised to the surprising value equal to and sometimes higher than that of hair felt, and that these boards may be nailed in place as readily as before perforating, for heat insulating purposes.

In the somewhat modified form of the invention shown in Fig. 3, the same construction is provided except the thin sheet or diaphragm 7 is placed on one surface of the fibrous board 1, in order to hide the ends of the perforations 2. This sheet or diaphragm 7 may be made of any desirable porous material, such for example as burlap or other fabric that can be readily colored or made to harmonize with the surroundings. In some cases, the sheet 7 may be made of Celotex or Insulite itself.

In the still further modified form of invention shown in Fig. 4, the perforations 2 are not carried entirely through the Celotex board 1, but are stopped short of one surface thereof so as to form the integral Celotex or Insulite portions 8, as illustrated. In this case, of course, the Celotex or Insulite surface 8 can be readily exposed in the room or enclosure and finished up as has been

heretofore done in the case of unperforated Celotex or Insulite, but the sound absorbing qualities of the board are somewhat impaired. However, in certain cases where it is not objectionable to show the open ends of the perforations 2, the presence of the integral portion 8 serves as a sort of trap to still further absorb the sound waves which are caught at the bottoms 9 of the perforations 2. In the case of Fig. 5, there is illustrated a Celotex board 1, which may be of the square shape shown, or it may have the rectangular shape 10, illustrated in Fig. 1. The only essential feature is that the board itself shall be of predetermined dimensions so that it will readily fit into the place it is to serve before it is brought to the building and to thus facilitate the construction of the enclosure. It is found in practice that the perforations 2, when grouped into a pleasing pattern such as is illustrated in Fig. 5, are not objectionable in many instances and one may leave said perforations open in the ceilings and even in the walls of living rooms. But when such perforations are found objectionable, as stated above, they may be covered with a suitable fabric or other porous covering 7, which can be readily tacked, nailed or otherwise secured to the insulating lumber boards 1, as readily as would be the case with other artificial lumber.

As regards the still further modified form of the invention shown in Fig. 6, the perforations 11 are made tapered or cone-shaped as shown so that the sound waves are gradually converged to a point as they penetrate the main body portion of the fibrous board and thus are more and more forced into the interior of the board and are thus effectually lost among the interstices of said board.

In a still further modified form of the invention shown in Fig. 7, the board 1 is provided with the elongated grooves 12 which may be of any desired contour or cross section and the sound waves readily enter the same and penetrate the interstices of the adjacent porous masses in the same manner as was disclosed in connection with Fig. 2. It should be remarked that in all cases, perforations or openings in the Celotex or Insulite boards are never molded. Should they be molded, they would inevitably form the above-mentioned objectionable skin or film which would reflect the sound rather than aid in absorbing the same. In making the perforations of this invention they are always cut, gouged, drilled or sawed out so as to tear loose the chips or shavings from the adjacent fibers, thus leaving a rough and fibrous surface to be readily penetrated by the sound waves.

In the still further modified form of the invention shown in Figs. 9 and 10, the perforations are of two diameters. The larger perforations 13 with which the board 16 is provided are preferably concentrically disposed with relation to the smaller perforations 14 with which the board 17 is provided, so that a sound wave entering the larger perforations would strike against the bottom walls 15 formed by the surface of the board 17, and they would naturally immediately be more or less compressed and forced into the smaller perforations 14, where they would enter the interstices of the individual masses 18 of the board 17.

As regards the construction shown in Fig. 8, it is found in practice that if the sound waves after passing through the perforations 2 are received into an open space such as 20, behind the board 1, they are reflected back and must pass again through the perforations 2 if they emerge at all but most of them are caught by the inner surface 21 of the board 1 and are reflected backwards and forwards until they are finally completely absorbed. In other words, a construction such as that shown in Fig. 8 can take care of a louder and greater volume of sound than is the case when no such space 20 is employed. The board 1 is conveniently spaced from the support or wall 22 by any suitable means such as the struts 23, and these said struts are conveniently provided with perforations 24 so that hot air or other medium having a density different from that of the room may be forced through such space 20 and thus further absorb the sound. In other words, it being well known that sound going from a medium of a given density to a medium of another density encounters a considerable resistance and therefore its energy is more or less consumed. I take advantage of this fact by providing either a colder air or a hotter air in the space 20 than is in the room into which the openings 2 enter and thus still further decrease the sound.

It will now be clear that in all the forms of the invention there is provided a sound absorbing construction involving a porous fibrous board 1 which is preferably of predetermined dimensions so that it constitutes a sound absorbing unit. It will further be clear that although this board or unit 1 has a highly porous interior, yet its surface, although porous, is not as porous as is its interior when cut through, or perforated by a gouging, punching, sawing or tearing action, and that therefore the raw edges of such perforations or openings serve to facilitate the entrance of sound waves into the interstices of the porous interior of said boards. It will further be understood that a board having a given number and disposition of openings per unit of area will have a certain determinable sound absorbing efficiency, and duplicate boards can be readily

produced, so that the sound absorbing capacity of a given number of square feet of perforated surface, may be readily determined in advance. This enables the architect to prepare a sufficient number of units of perforated surface for any given enclosure and to know with certainty their sound absorbing effect before they are put in place.

What is claimed is:—

1. A sound absorbing construction comprising a building board of fibrous material having a porous interior with sound absorbing properties, and provided with independent artificial openings extending inwardly from a surface of said material, whereby sound waves may enter said openings and be absorbed by said porous interior.

2. A sound absorbing construction comprising a building board composed of vegetable fibres and having a porous interior possessing sound absorbing properties, and provided with a predetermined number of independent artificial openings of larger dimensions than are the pores of the material and extending inwardly from a surface thereof, whereby sound waves may enter said openings and be absorbed by said interior.

3. A sound absorbing construction comprising a building board composed of bagasse fibres and having a porous interior possessing sound absorbing properties and provided with artificial openings extending into said interior and communicating with the pores thereof, whereby sound waves may enter said openings and be absorbed into the pores of said interior.

4. The herein described sound absorbing unit composed of a porous bagasse fibre board of predetermined dimensions and provided with artificial openings extending into the interior thereof, whereby sound waves may enter said openings and be absorbed.

5. The herein described sound absorbing unit composed of a board made from a mass of compressed bagasse fibres and having a porous interior, said board provided with numerous openings communicating with said interior and adapted to conduct sound waves to the pores thereof.

6. The herein described sound absorbing member consisting of a building board composed of compressed bagasse fibres providing a porous interior and having a sufficient number of openings communicating with said interior to substantially increase its sound absorbing qualities.

7. In a sound absorbing construction, the combination of a fibrous porous building board of sound absorbing material provided with openings communicating with its interior; a wall; and means to space said layer from said wall.

8. In a sound absorbing construction, the combination of a fibrous, porous building board of sound absorbing material provided with perforations extending entirely through said layer; a wall; and means to support said layer away from said wall and provide a space into which said perforations open.

9. As a new article of manufacture, a sound absorbing unit of known value consisting of a fibrous porous building board provided with a predetermined number of perforations extending inwardly from one of its surfaces and having a known sound absorbing capacity.

In testimony whereof I affix my signature.

WILBUR S. TRADER.