

July 4, 1939.

G. E. HUDSON
ACOUSTIC MATERIAL
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2,165,101

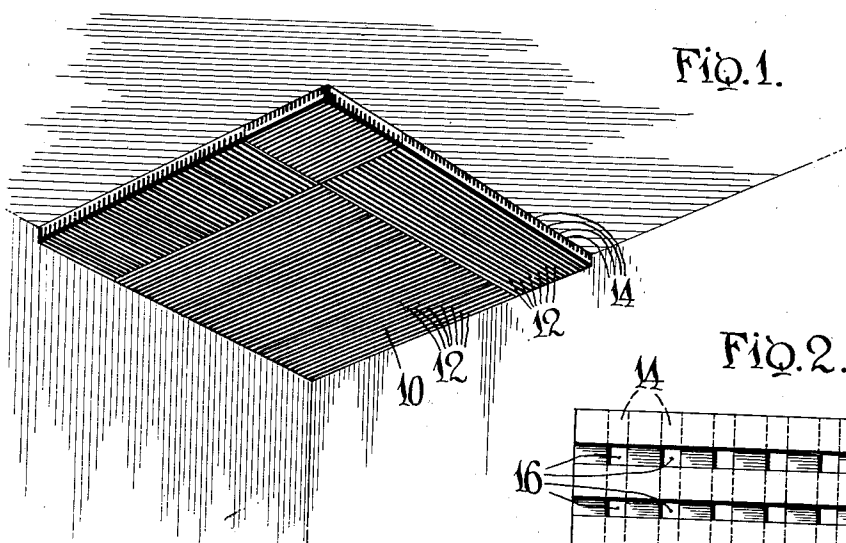


FIG. 1.

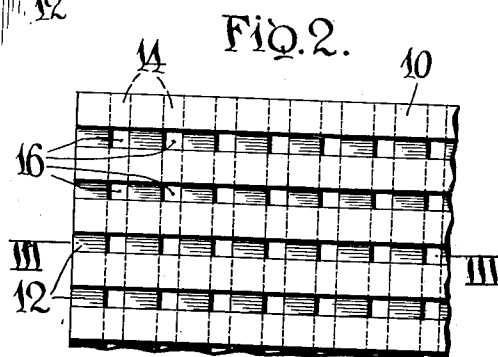


FIG. 2.

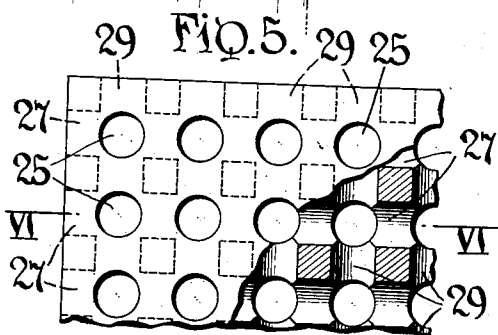


FIG. 5.

FIG. 3.

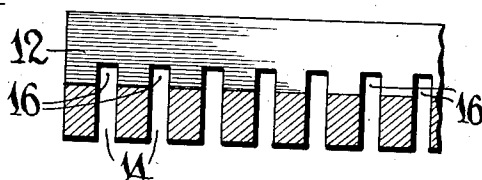
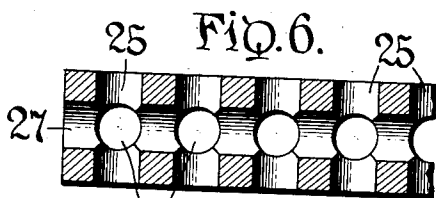


FIG. 6.

FIG. 4.

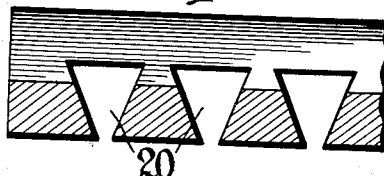
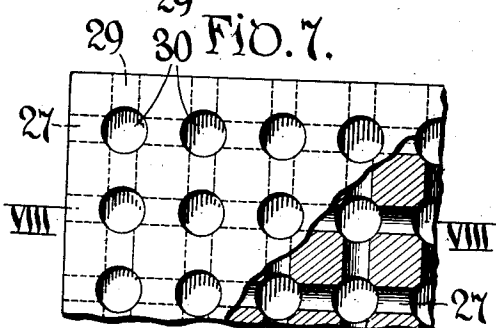


FIG. 7.

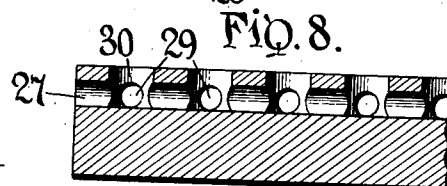


FIG. 8.

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ACOUSTIC MATERIAL

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Application January 6, 1938, Serial No. 133,679

8 Claims. (Cl. 72-18)

This invention relates to sound absorbing material and it has for one of its primary objects to provide an article of manufacture of improved sound absorbing capacity.

Another object of the invention is to provide an improved sound absorbing material that may be manufactured in the form of units for convenience in application to the walls, ceilings, or other surfaces of rooms.

Another object is to provide an improved sound absorbing material unit which is so designed as to be susceptible of manufacture by means of simple and inexpensive manufacturing processes.

Another object is to provide a sound absorbing building unit capable of being packed and handled in connection with its transportation to the point of its use with a minimum of injury and breakage.

Another object is to provide a sound absorbing building unit which is capable of being attached to a supporting surface in an improved and a more permanent manner than in the case of previous forms of sound absorbing materials.

Another object is to provide an improved sound absorbing block that is capable of receiving a surface treating application for enhancing the appearance thereof without detracting substantially from the sound absorbing efficiency of the material. These and other objects and advantages of the invention will be more fully hereinafter disclosed in the claims and in the specification which is exemplary thereof.

In the drawing:

Fig. 1 is a perspective view of a fragmentary installation of my improved material upon the ceiling of a room;

Fig. 2 is a fragmentary plan of a block of material constructed in accordance with the invention;

Fig. 3 is a fragmentary sectional view taken substantially along line III-III of Fig. 2;

Fig. 4 is a fragmentary sectional view similar to Fig. 3 of another form of the invention;

Fig. 5 is a fragmentary plan of a block of material incorporating another form of the invention, with a portion broken away to reveal the interior thereof;

Fig. 6 is a section taken substantially along line VI-VI of Fig. 5;

Fig. 7 is a fragmentary plan of another form of the invention, with a portion broken away to show the interior thereof;

Fig. 8 is a section taken substantially along line VIII-VIII of Fig. 7.

It is well known that objectionable acoustic

conditions exist in rooms whenever the boundary surfaces thereof are of such nature as to reflect sound waves back and forth between one another. The most desirable form of room construction therefore comprises a wall and ceiling structure capable of absorbing a predetermined portion of the on-coming sound waves at the first time of contact. I am aware that many previous attempts have been made to provide material for sound absorbing purposes, but with varying degrees of success. These previous forms of material have been subject to many disadvantages, such as insufficient sound absorbing capacity, high cost of manufacture, difficulty of installation, non-permanence of sound absorbing efficiency and undesirability of appearance.

As illustrated in the drawing, sound absorbing material may be made in accordance with the present invention by providing two separate series of openings extending into the material, individual members of the series being arranged to intersect transversely within the interior thereof. For instance, Figures 2 and 3 illustrate one form of the invention wherein the outer or sound receiving portion of the material is provided with a series of parallel grooves 12 extending from the face thereof a substantial distance into the interior of the material. The reverse or wall contacting portion of the material is traversed by a second series of parallel grooves 14 which extend from the face thereof into the interior of the material a sufficient distance to intersect the grooves 12 in such manner as to provide a series of groove interconnecting chambers 16 within the interior of the material. Hence, means have been provided adjacent the outer portion of the material for receiving on-coming sound waves and conveying them inwardly of the material by means of uniformly disposed slots and then re-directing the sound waves into transversely disposed chambers within the inner or wall adjacent portion of the material. Thus, the sound waves are substantially trapped within the interior of the material. The material is preferably formed of some suitable sound absorbing substance such as vegetable, mineral or animal fibrous or porous substance or artificial combinations and/or compositions thereof, so that subsequent to the initial trapping of the sound waves within the interior of the material, the pores and fibers thereof disseminate and absorb the sound waves therein without permitting substantial retransmission thereof to the outer surface of the material.

It will be obvious that the form of construc-

tion illustrated in Figs. 2 and 3 lends itself readily to manufacture in connection with large scale production methods. For example, the material may be made in the form of blocks or plaques of the thickness required to provide the necessary sound absorbing capacity in any given instance of use; and may be made of any desired plan dimensions to enable the units to be manufactured and handled during shipping and installation in a convenient manner. Also, the units may be provided in any desired plan shapes for ornamental pattern forming purposes. The blocks may be conveniently manufactured from cementitious substances such as lime, gypsum and cement products in combination with any desired filler and/or binding and/or reinforcing materials; and it is contemplated in this respect that any of the well known building materials may be used for this purpose. In the case of cementitious material substances, the blocks may be formed by molding the material when in plastic form between opposed dies, and when the material is hardened the dies may be withdrawn leaving a rugged block of rectangular outer contour formed in accordance with the description of Figs. 2 and 3.

Vegetable materials, either in their natural form or as artificial compositions, lend themselves particularly well to the manufacture of blocks incorporating the principles of the invention. For instance, natural wood or artificial felted masses of vegetable fiber may be sawed or cut into at opposite faces to provide sound absorbing structures in finished form of the type illustrated in Figs. 2 and 3. In connection with this method of providing the invention the operation of the saw teeth through the fibers interiorly of the material tends to loosen the fiber lock between fibers adjacent the saw cuts so that the porosity of the material at these points is substantially increased, hence facilitating the sound absorbing operation within the material.

Another important feature of the invention resides in the fact that a sound absorbing unit made in accordance with the invention as explained in connection with Figs. 2 and 3 is adapted to be attached to a wall or ceiling surface in an improved and more permanent manner. It has been found that blocks of this general nature may conveniently be attached to a wall or ceiling surface by means of a glue or cement substance, and it has in fact become the custom of building constructors to attach previous forms of acoustic tile to the receiving surface by means of a paste or glue. Under certain conditions and for varying amounts of time such method of attachment has proven satisfactory, but under adverse moisture and/or temperature conditions it has been found that in the case of previous forms of acoustic tile they ultimately warp and work loose from their supporting surface. This action is particularly prevalent in the case of materials having relatively large coefficients of expansion because of the warping action developed in connection with unequal expansion of the inner and outer portions of the material.

By means of the present invention the possibility of warping action is obviated or at least minimized. This is because of the fact that the inner and outer body portions of the material are separately severed by series of openings with the result that unequal expansions or contractions of the material are absorbed by changes in the sectional dimensions of the openings in the material of the series furthest removed from

the wall or supporting surface to which the material is attached. Consequently, the expansion or contraction stresses in the material are disposed in a plane spaced at a substantial distance away from the points of cemented or other form of connected contact between the block and the supporting surface by reason of which the effectiveness of the stresses from the standpoint of disrupting the connections is greatly reduced. There is thus provided a sound absorbing material unit adapted to readily receive a coating of glue or cement on one side surface thereof in a manner analogous to the application of the coating of glue or cement which is usually applied to previous forms of acoustic tiles, and which is adapted to remain upon its supporting surface after being applied thereto in a more sure and permanent manner. Because of the ability of my material to remain in permanently glued relation upon its supporting surface, as hereinabove described, it will be apparent that a lesser amount of glue will be required to permanently secure my material to a supporting surface, as compared to other types of acoustic materials; and if desired my material may be secured to a supporting surface by means of relatively small amounts of glue placed thereon in the form of spaced applications, as distinguished from a uniform overall application of glue as hereinabove described. In the case of this latter type of glue application it will be seen that the spaced points of glue application will support the sound absorbing material in slightly spaced relation from the supporting surface, and there will thereby be provided a slight gap between the unglued body portions of my material and the supporting surface which will function as a further sound entrapping and absorbing feature of the finished construction. It will also be apparent that my improved material is adapted also to be attached to its supporting surface by means of wiring or any other suitable means such as are known to the building art.

The severance of the outer and inner body portions of my material as hereinabove described provides, in the case of a construction unit of block or plaque-like form, a unit possessing a further important advantage in that it is readily deformable, as by bending, without subjecting the material of the unit to rupturing stresses. This ability of the unit to withstand bending without breaking enables it to be applied upon curved wall or other supporting surfaces, such as cornices, columns or other rounded surface structural foundations, without special additional preparation and without special additional tying or other connecting means. Due to the transverse disposition of the grooves therein, a block of my material may also be readily deformed without the imposition of rupturing stresses thereon into suitable shape for application upon a spherically shaped supporting structure. Thus, a sound absorbing material capable of application in unit form in a further advantageous manner is provided. It will also be understood that the grooves in the inner body portion of my unit provide, alone, at least to some extent, the non-warping and deformable features hereinabove described, and that in lieu of the slot type openings shown in the outer sound receiving face of my material I may employ any other type of sound receiving openings therein in combination with the slotting of the rear face. I thus provide a unit of material capable of absorbing sound and of being distorted to conform to curved sup-

porting surfaces and capable of avoiding the warping action described hereinabove. It will also be understood that the openings extending into the inner body portion of my material may be in any desired form of recessions so long as they function to partially sever the body of the material to prevent direct transmission of expansion and contraction forces in the unsevered portion of the body material to the wall contacting portion thereof. Therefore, the openings extending into the inner portion of the material may be of any desired shape and dimensions and number, and in any relative spaced relation as may be necessary in any given instance.

By reason of the provision of the sound wave conveying grooves 12 the uninterrupted outer surface portions of the block between the grooves may be treated with a coating of paint or other material treating substance for the preservation or beautification thereof even though this surface treating substance may be of such character as to provide a non-porous finished surface thereon; the grooves 12 being unaffected in their sound wave conveying capacity.

Fig. 4 illustrates another form of the invention wherein dovetail shaped grooves 20 are provided in lieu of the parallel sided grooves shown in the form of Figs. 2 and 3. This construction provides a somewhat different type of sound wave trapping and absorbing action as will be apparent when considered in connection with the hereinabove description of the principles of the invention. The convergence of the side walls of the grooves 20 toward the sound receiving face of the material augments the sound wave trapping ability of my product because of the substantial elimination of the possibility of the sound waves rebounding out of the grooves 20 after having been received therein.

Figs. 5 and 6 illustrate another form of the invention wherein circular holes 25 are employed in lieu of the grooves 12 of the form shown in Figs. 2 and 3. These holes 25 may be provided in any desired dimensions and relative spaced arrangement, and are so disposed as to be in communication with the open air adjacent the outer face of the block. Intermedially of the block a second series of transversely disposed holes 27 are arranged in intersecting relation relative to the holes 25, and a third series of holes 29 may be provided and so arranged as to extend laterally throughout the block and to intersect with the holes 25 at the points of intersection of the holes 25 and 27. Thus a structure has been provided wherein sound wave conveying means in the form of openings 25 are in communication interiorly of the block with transversely extending chambers 27 and 29 in such manner that sound waves entering through the openings 25 are substantially trapped within the interior of the block and are disseminated and diverted by the interior walls thereof into the material forming the body of the block where they are absorbed without substantial retransmission to the outer surface of the block. Particular attention is called to the fact that the laterally disposed sound wave trapping openings of the invention are of continuous and uninterrupted form. Consequently, when sound waves enter through adjacent sound wave conveying openings and are reflected laterally therefrom throughout the interiorly disposed openings, they are directed into opposing paths of motion and there is thus set up a self-damping or neutralizing action between portions of the sound waves which assists mate-

rially in the sound destroying performance of the material. The lower end portions of the holes 25 sever the body of the block adjacent the wall or other support upon which the unit is applied, and hence the advantages with respect to acoustic properties and non-warping and permanent fastening characteristics hereinabove described in connection with the construction of Figs. 2 and 3 are obtained. It will be apparent that the openings 25, 27 and 29 of the construction of Figs. 5 and 6 may be conveniently and economically provided by drilling a solid block of material from its side faces by gangs of drills.

Figs. 7 and 8 illustrate a form of the invention somewhat similar to that illustrated in Figs. 5 and 6 wherein sound wave conveying openings 30 are provided in a manner somewhat similar to the openings 25 of Figs. 5 and 6 with the exception that the openings 30 terminate intermedially of the block and adjacent the plane of intersection between the openings 30 and the transverse openings 27 and 29. In this form of the invention the incoming sound waves are reflected and directed into the transverse channels 27 and 29. As illustrated in Figs. 7 and 8, the ratios of the sectional dimensions of the sound wave conveying openings and the interiorly disposed sound wave disseminating openings may be varied to provide different types of sound absorbing performance. In the form illustrated in Figs. 7 and 8 the openings 30 are of diameters substantially greater than the diameters of the transverse openings 27 and 29, and the depth of the openings 30 is less than the diameters thereof. It has been found that this specific form of construction provides very desirable acoustic results and a mechanically rigid and durable finished block product. If desired, the under surface of this form of the block may be grooved as illustrated in Fig. 3 to provide for the improved method of attachment described hereinabove.

Although only a limited number of forms of the invention have been described and shown herein it will be understood that the invention is not so limited but that various changes can be made therein without departing from the scope and spirit of the invention claimed.

I claim:

1. A sound absorbing unit comprising a block of material provided with series of parallel slots extending inwardly thereof from each of its major faces, said series of slots being disposed in transverse relation to one another and intersecting intermedially of said block for a substantial distance.
2. A sound deadening construction comprising a single integral unit of material which has sound absorbing characteristics, and having therein independent artificial openings extending inwardly from a surface of said material and communicating interiorly of said material with transversely disposed independent artificial openings of continuous uninterrupted form extending inwardly from an opposite surface of said unit.
3. A sound absorbing unit for mounting upon a supporting surface having a normally exposed surface provided with sound absorbing openings, and an opposite cement receiving surface interrupted by openings therein to provide a series of spaced unit portions for contact with said supporting surface, said sound absorbing openings and said surface interrupting openings intersecting interiorly of the unit to provide sound wave disseminating channels.
4. A sound absorbing unit comprising a block of

material provided with a series of parallel slots extending inwardly from its outer or sound receiving face, said slots being of dovetail sectional form, and a second series of parallel slots extending inwardly of said block from its face opposed to said sound receiving face and in intersecting relation with said dovetail shaped slots.

5. A sound absorbing unit comprising a block of material provided with a series of parallel sound wave receiving openings extending inwardly of said block from its outer or sound receiving face, second and third series of parallel openings extending through the interior of the block in transverse relation one to another and intersecting said series of sound wave receiving openings to provide sound wave disseminating channels, and a fourth series of openings extending inwardly of said unit from its face opposed to said sound receiving face and intersecting said sound wave disseminating channels.

6. A sound absorbing unit for mounting upon a supporting surface in the form of a block having a normally exposed surface provided with sound wave receiving openings and an opposite cement receiving surface slotted to provide

a series of spaced unit body portions for cemented contact with said supporting surface, said sound wave receiving openings and said slots being arranged to intersect interiorly of the unit.

7. A sound absorbing unit for mounting upon a supporting surface comprising a block of material having a normally exposed surface provided with sound wave receiving openings extending inwardly therefrom, and an opposite cement receiving surface slotted to provide a series of spaced unit portions for cemented connection with said supporting surface, said sound wave receiving openings and said slots intercommunicating interiorly of the unit to provide sound wave disseminating channels.

8. In combination, a supporting body and a sound absorbing unit including means at the outer surface portion thereof for receiving and deadening sound, the sound absorbing unit being mounted against the outer surface of said supporting body and being provided with a slot extending inwardly of the body portion thereof from its rear face and partially severing the body portion of said unit.

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