

July 19, 1932.

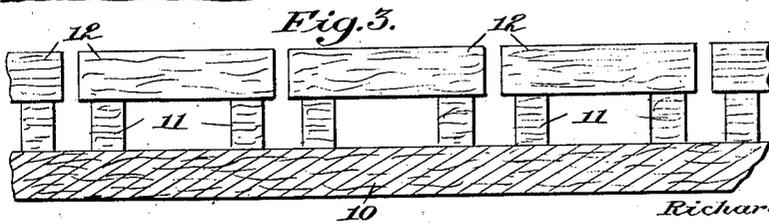
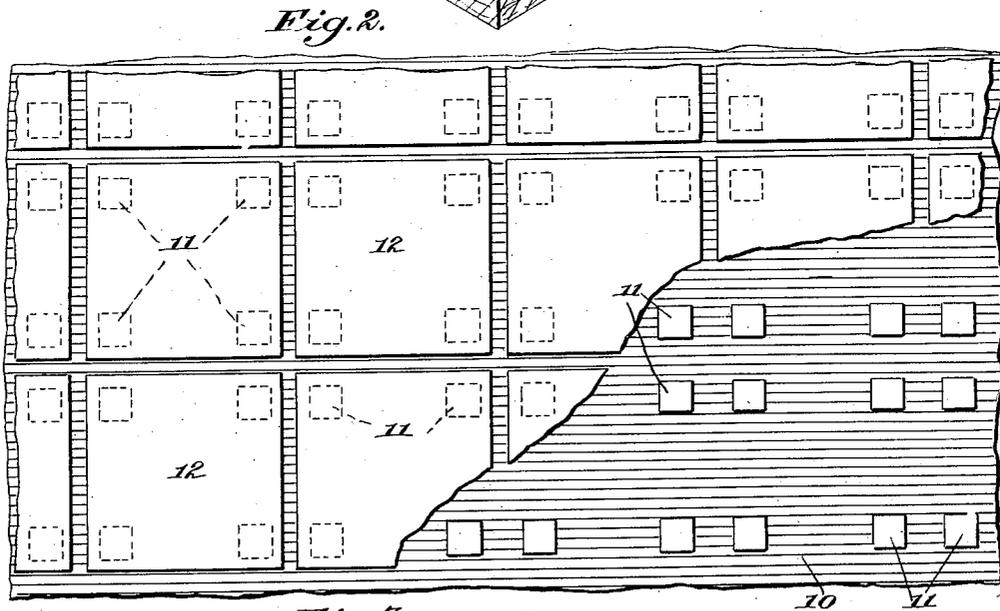
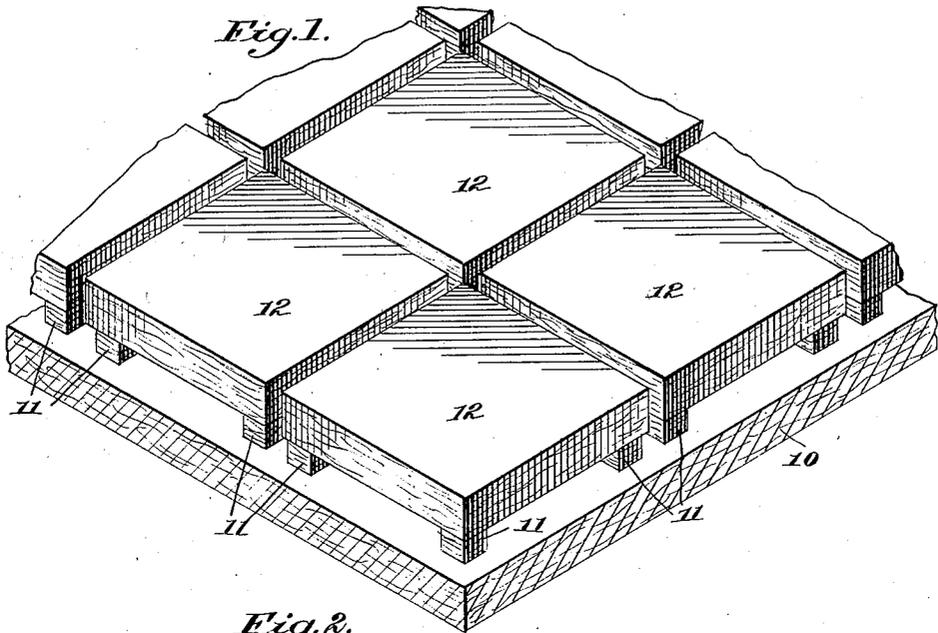
R. C. BROCKMEYER

1,867,549

SOUND ABSORBENT MATERIAL

Filed July 19, 1929

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

Fig. 4.

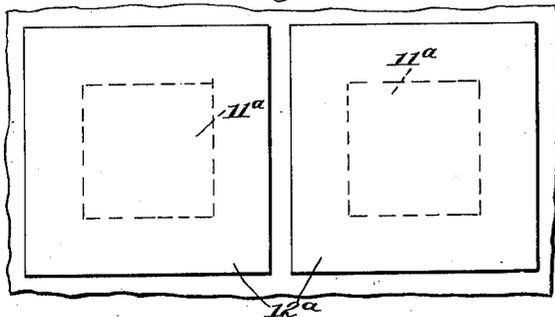


Fig. 8.

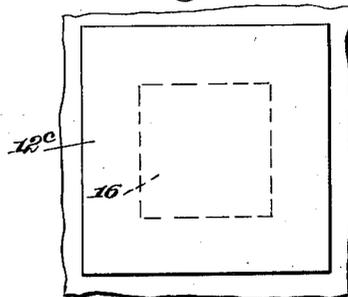


Fig. 5.

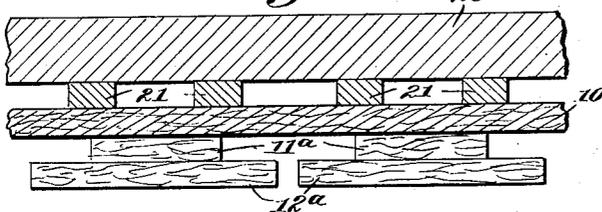


Fig. 9.

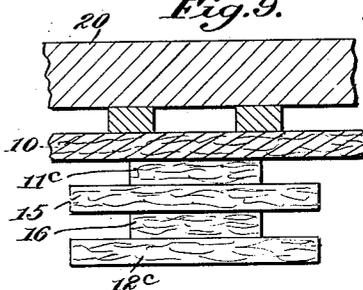


Fig. 6.

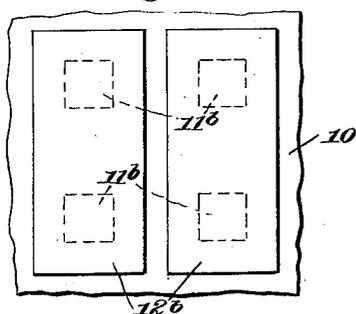


Fig. 10.

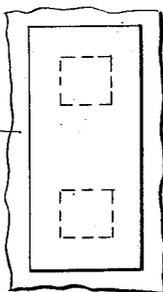


Fig. 12.

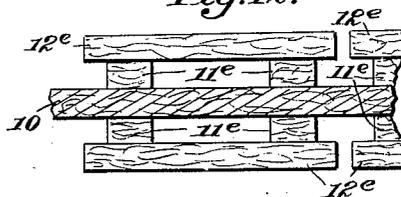


Fig. 7.

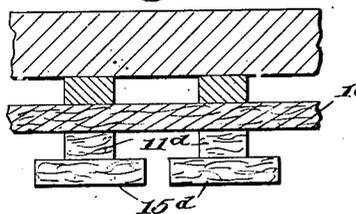
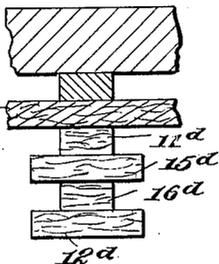


Fig. 11.



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UNITED STATES PATENT OFFICE

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SOUND ABSORBENT MATERIAL

Application filed July 19, 1929. Serial No. 379,503.

This invention relates to improvements in sound absorbent material and more particularly relates to the provision of a material of this type which is to be employed for the visible surface of the wall or ceiling.

It is well known that many wall materials are highly reflective with respect to sound waves so that echoes continue for a long time, and lead to confusion between the echo reception of one word and the direct reception of another word. Such reverberatory walls make it difficult for a speaker or musician to convey an intelligible message.

Many proposals have been made to eliminate this difficulty, some of the most satisfactory of these involving the employment of wall and ceiling materials which are of porous nature and hence tend to receive and absorb a part of the sound waves incident upon them and reflect the rest. Such materials are felts, and porous substances of wood pulp, wood fibre, etc. It has been found, however, that the absorptive capacity of such surfaces is not sufficient to decrease the intensity of the echo or reflection to below a certain percentage which may be designated as the "point of toleration" at which the weak echoes do not interfere with and mutilate the quality of the later sound waves to an extent such as to confuse them. It therefore becomes necessary to increase the relative absorptiveness of the wall and ceiling materials.

It has been proposed for this purpose to provide felts and "pulp board" etc. with apertures or recesses extending down into the material whereby the physical porosity is enlarged, to the extent that the sound waves which normally would strike the sheets at the points of these recesses, pass down into the recesses and are absorbed by the structure thereof in the greater area thus afforded. A particular advantage of providing such apertures is that the usual method of preparation of such felts and boards leads to a greater diminution of the porosity at the surfaces, than at the interior of the board, owing to the compression employed during fabrication. It has, however, been found in practice that the most efficient results are obtained with

such structures by having a definite coefficient of absorption for the material to be employed at a given point: and that this coefficient of absorption must vary from point to point of a chamber for the obtaining of the best effects. With such material, prepared in manufacture with recesses, it is necessary to provide a number of grades of material of which each has a different specific coefficient of absorption. It is not possible to adjust the absorptiveness of a particular surface except by entirely replacing it by another surface: and hence it is necessary for the engineer in designing the absorptive wall or ceiling to calculate with great closeness the desired quality or absorptiveness to be employed for each particular sub-area of the wall or ceiling,—a condition which can only be estimated empirically, and is not competent of accurate results, owing to the variations thereof arising from changes of relative absorptiveness at other portions of the walls and ceiling.

It is therefore proposed according to the present invention, to provide a wall or ceiling material in which the coefficient of absorptiveness may be varied during the actual placing of the material in the building, according to the requirements of the particular sub-area with respect to the other portions of the walls and ceiling.

Another feature of the present invention is the provision of such a material having an internal sound absorptive labyrinth to prevent re-emission of sound waves which have entered interstices or recesses provided in the material.

A further feature of the invention is the provision of such a material adapted to decorative effects over large areas.

Still another feature of the invention is the provision of such material by which may be modified, during placing or even after it has been placed, the coefficient of absorption at any sub-area of the wall or ceiling whereby the sound waves producing the echoes may be controlled, absorbed and distributed in such manner as the acoustical engineer may order.

With these and other objects in view, illus-

trative forms of practicing the invention have been shown on the accompanying drawings, in which:

Figure 1 is a perspective view of a portion of the material in its assembled form.

Fig. 2 is a corresponding plan view, with portions broken away to show the construction thereof.

Fig. 3 is a sectional view through a portion of the material.

Fig. 4 is a plan view of a modified form of construction.

Fig. 5 is a corresponding sectional view.

Figs. 6 and 7 are similarly plan and section views of a further modified form of construction.

Figs. 8 and 9 are respectively plan and section views of still another modification.

Figs. 10 and 11 are plan and sectional views of a fifth modified form.

Fig. 12 is a sectional view showing the employment of the material as a very thin sound-proof partition.

According to these drawings, the sound absorptive material comprises a base sheet having a plurality of upstanding feet thereon upon which are mounted tables whose external surfaces constitute the wall or ceiling surfaces of the room, and whose internal surfaces in conjunction with the feet and base member form a sound absorbent labyrinth. The tables are so arranged with respect to one another that apertures of variable but predetermined widths may be provided therebetween for the passage of sound waves from the general chamber of the apartment into the sound labyrinth.

In Figs. 1 to 3, inclusive, the base member 10 is illustrated as being of hair felt or similar absorptive material. The feet 11 are secured to the hair felt at spaced intervals and themselves receive the tables 12. For example, the tables, feet and hair felt may be joined together by gluing. It is preferred to form the feet and tables of a relatively stiff but porous sound absorbent material such as the compressed wood fibre available on the market, as a stiff material obtainable in sheets of large superficial dimension and a uniform thickness of approximately one-half of an inch. It will be understood that other materials having similar and desirable properties may be substituted. This material in its sheet form may be cut on the job to provide feet which will hence be of definite length from the base member 10 to the table 12, and by reason of the uniform thickness of the tables themselves, the outer surface of these tables, exposed to the chamber, will be accurately in a plane, if this is desired, and without requiring great skill or complicated machinery during the manufacture and placing.

Likewise, the tables 12 may be formed of such materials of any desired size and shape.

In locating the feet, due attention is paid to the size and shape of the tables so that the feet support the respective tables with slight spaces therebetween as indicated in the perspective view of Fig. 1. The specific absorptiveness per unit of area therefore varies, up to a certain width of aperture between the tables, practically as a linear function of the portion of the wall area which is occupied by table areas. With a given width of groove, this absorptiveness will be increased by decreasing the size of the tables: while with a given size of table, the absorptiveness will be increased by increasing the width of the groove. In practice, it may be pointed out that excellent results are obtained by the employment of tables varying in size from an inch square to twelve inches square and separated by grooves of the order of one-eighth of an inch.

When the material is located in position on a wall or ceiling, any sound waves encountering it will in part encounter the tables and in part pass through the grooves between the same. The portions of sound waves encountering the tables are partly absorbed and partly reflected. The portions entering the grooves pass downward and into the labyrinth existing at the inner side of the tables 12 and defined by the inner sides of these tables, the feet 11 and the surface of the base member 10. By providing the base member 10 of relatively highly absorbent material such as hair felt, in the preferred form, the sound waves entering the grooves are practically totally extinguished or absorbed by continued reflection within the labyrinth: so that it is very easy to calculate the size of table and width of groove which will afford a definite specific coefficient of absorption. It will be noted that the highly absorbent hair felt base member 10 is not exposed to the exterior of the room, while the tables 12 are of relatively harder material and are susceptible of painting with properly selected pigments and vehicles for decorative effects.

According to the form of execution of Figs. 1 to 3, four feet 11 are provided beneath each table 12, so that the table is held fixedly in its desired position and a large labyrinth chamber is provided, including passages extending directly behind the tables 12.

In the form of execution of Figs. 4 and 5 a single large foot 11a is employed beneath the table 12a, this form of device being preferred when the tables are of relatively small sizes, i. e., having an area of a few square inches.

In Figs. 6 and 7, the tables 12b are provided with the feet 11b, two of these feet being provided for each of these tables. It will be understood that each table, with its feet, in this illustration, is substantially equal to one-half of a table in Fig. 2; although in

either case any number of feet may be employed, being spaced apart in two dimensions in Fig. 2 and in one dimension (i. e., along the length of the table 12*b*) in Fig. 6. Further, the sizes and shapes of the tables, and the corresponding arrangement of the supporting feet, may be varied for purposes of decoration and to break the monotony of definite units and straight lines: while maintaining the desired ratio of table surface to grooves for the particular sub-area in question, this ratio varying from point to point of the wall, if so desired, by due proportioning of the sizes and shapes of the tables and of the grooves.

In Figs. 8 and 9 it will be seen that the invention is not limited to the provision of the tables 12 supported directly from a base member 10 by the feet 11. In Figs. 8 and 9 the base member 10 receives the feet 11*c* which support an intermediate table 15 upon which is mounted a further foot 16 receiving the exposed table 12*c* proper. In this instance, the feet provide in effect two separate sub-labyrinths spaced apart by the intermediate table 15, whereby even the most intense sound waves are totally absorbed upon entering the respective grooves.

In Figs. 10 and 11, the base member 10 likewise is provided with a plurality of feet 11*d* to receive the intermediate table 15*d* supporting the further feet 16*d* carrying the table 12*d*. It will thus be seen that the invention is limited neither with respect to the number of feet to be employed for supporting a particular table, nor to the number of tables to be located one on top of another.

In Fig. 12, the base member 12 receives feet 11*e* at both sides to support the individual tables 12*e* directed toward the respective sides of the room. This provides a very simple and highly efficient sound absorptive partition where great thinness is required; and such partitions may be of permanent or portable nature.

Although the sheets may be manufactured in quantity, it is preferred to prepare them at the work, by providing a suitable number of feet and tables of the desired sizes and shapes. The wall or ceiling 20 to be treated is prepared with a number of furring strips 21 to which is secured as by tacking or cementing, the base member 10, and then the feet are secured thereto in suitable distribution, and finally the tables in turn secured to the feet.

If after construction it is found that echoes of undesirable extent arise from any particular wall section, the particular section may be cheaply and easily corrected by varying the size and shape of the tables whereby the ratio of groove to table is suitably changed.

It will be noted from each of the figures, that according to my construction the sur-

face comprises tables with openings between the tables at the exposed surface, and extending in various directions, each of these openings preferably having a greater length than width; with a labyrinth beneath the tables within which the sound wave is absorbed, these labyrinths comprising enlarged cavities at the bases of the several openings, for which purpose the feet are made of lesser dimensions than the tables.

It is obvious that the invention is not restricted in employment to the forms shown but that it may be employed in many ways within the scope of the appended claims.

I claim:

1. In an insulating material for walls or ceilings, a plurality of tables of said absorptive material providing a wall surface, said tables being spaced to provide sound-penetrable openings in said surface, a plurality of intermediate tables of sound absorptive material located between said surface tables and the wall or ceiling, and plural supporting means of sound absorptive material to hold said tables on said wall or ceiling, each said supporting means being smaller than the adjacent tables whereby to form a sound-absorbing labyrinth beneath said surface tables.

2. In an insulating material for walls or ceilings, a sheet of sound absorbent material forming a continuous base member, feet fastened to said base member, and a plurality of tables for covering said base member and providing the exposed surface of said wall or ceiling and having sound absorbent surfaces of greater area than the feet and fastened thereto in spaced relation to one another with sound penetrable openings therebetween, whereby a labyrinth is provided beneath the tables with access of sound waves to said labyrinth through said openings.

3. In an insulating material for walls or ceilings, a continuous base member of sound absorbent material, a plurality of tables for covering the base member and providing the exposed wall or ceiling surface, said tables having openings therebetween for the passage of sound waves, and a plurality of sound absorbent feet for connecting said base member and tables, the lower surfaces of said tables being sound absorbent, said tables, base member and feet forming a sound absorbent labyrinth beneath the said exposed surface.

4. In an insulating material for the wall or ceiling of a room, a substantially continuous sound absorbent base member, feet of sound absorbent material secured to said base member and located at spaced intervals thereon, tables of greater area than said feet and secured to said feet for covering the base member and providing the exposed surface of said wall or ceiling, said tables comprising sound absorbent material at the side adjacent said feet and supported in mutually spaced relationship on said feet

whereby to provide openings between said tables through which the sound waves may penetrate from the room, said base member, feet and the lower surface of said tables
 5 providing a substantially closed labyrinth which is open only through said openings and has absorbent walls for the absorption of the sound waves penetrating thereto.

5. In an insulating material for walls or
 10 ceilings, a substantially continuous base member, sound absorbent feet secured to said base member, sound absorbent tables fastened to said feet and spaced apart to provide sound penetrable openings between
 15 said tables, said tables covering said base member and at their sides opposite said feet providing the exposed surface of said wall or ceiling, said openings and the areas of said opposite sides of the tables being in predetermined proportion to one another to provide an exposed wall or ceiling surface having a predetermined coefficient of absorption, said base member, feet and the lower surfaces of the said tables defining a substantially closed sound absorbent labyrinth constituting an enlargement of said openings and open only through said openings and providing intercommunication beneath said tables for the reception and absorption of sound waves passing through said openings.

6. A sound absorptive wall or ceiling construction comprising a substantially continuous base member, feet secured to said member at spaced intervals, and a plurality of tables secured to said feet and covering said base member, each of said tables being secured to a plurality of feet whereby the exposed surface of the table is held in stable position with the adjacent edges of the tables spaced apart to provide openings, said
 40 tables at their sides opposite said feet providing the exposed surface of the wall or ceiling and having their sides adjacent said feet constituted of sound absorbing material, said feet being of sound absorbing material, whereby a labyrinth is formed beneath said tables for the absorption of sound waves which pass through said openings.

7. In an insulating material for walls or
 50 ceilings, an imperforate substantially plane base member, feet of sound absorbent material secured to said base member at spaced intervals, and rectangular plane tables having absorptive surfaces directed toward said
 55 base member, said tables being secured to said feet and located parallel to and covering said base member and providing at the side opposite said feet the exposed surface of the wall or ceiling, said tables being spaced apart to provide slots of substantially uniform width therebetween through which the sound waves may pass to the space beneath the tables.

8. In an insulating material for walls or
 65 ceilings, a substantially continuous base mem-

ber, a plurality of independent sound absorbent feet fastened to said base member at spaced intervals, and a plurality of tables covering said base member, each table being of greater area than the adjacent feet and each having a sound absorptive surface directed toward said base member, each of said tables having one of its sides secured to one of said feet and thereby held with its other side substantially parallel to said base member for providing the exposed surface of the wall ceiling, said tables being spaced apart to provide openings therebetween of substantially uniform width through which the sound waves may pass to the space beneath the tables.

In testimony whereof, I affix my signature.
 RICHARD C. BROCKMEYER.

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