Oct. 11, 1938. R. V. PARSONS 2,132,642

SOUND ABSORBING UNIT

Filed July 21, 1932

Fig. 1.

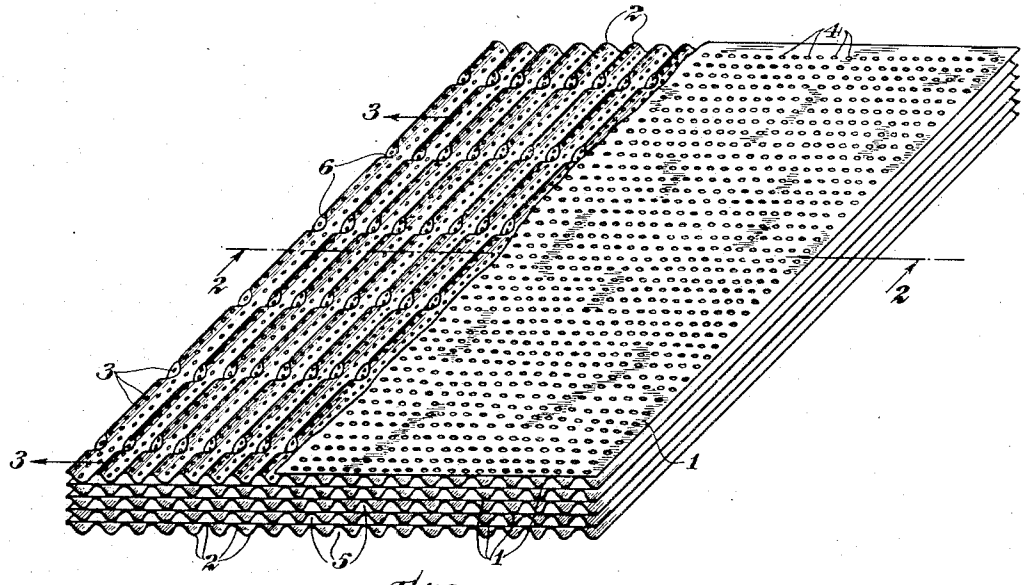


Fig. 2.



Fig. 3.

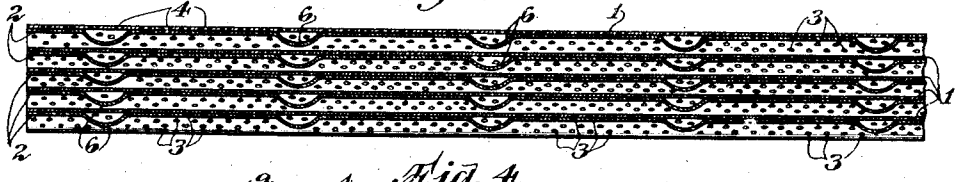


Fig. 4.



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SOUND ABSORBING UNIT

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Application July 21, 1932, Serial No. 623,799

4 Claims. (Cl. 154—45)

This invention relates to a sound dissipating and sound absorbing unit and particularly to one provided with a labyrinth of intercommunicating spaces between materials that may be relatively ineffective per se in absorbing sound.

A preferred embodiment of the invention comprises composited, spaced sheets of asbestos paper or the like that are discontinuously perforated. The spaces may be constricted at intervals with barriers or other means for deflecting sound and causing it to pass, in part, from a given space through perforations into an adjacent space.

It is conventional to absorb sound in capillary or other small spaces in felts and similar materials. Also, there are acoustical constructions in which a felted sheet is provided with perforations adapted to permit the entrance of sound into the perforations and, through the side walls of perforations, into the multiplicity of small spaces between the individual fibers composing the sheet. In such constructions, the perforations are relatively large, whereas the spaces between the fibers are smaller, in fact very much smaller in area of cross section than the perforations.

The present invention provides a novel type of acoustical unit in which perforations communicate with laterally extending passages that may be much larger than the perforations. Also, the invention provides a preformed sound absorbing unit or block that is inexpensive to manufacture, light in weight, effective in thermal insulation, and adapted to be decorated without the necessity of applying an independent facing member over the exposed surface. Other objects and advantages of the invention will appear as the description thereof progresses.

The invention is illustrated in the drawing in which

Fig. 1 is a perspective view, broken away in part for clearness of illustration, of a preferred form of sound absorbing unit.

Fig. 2 is a cross section taken on the line 2—2 of Fig. 1.

Fig. 3 is a cross section taken on the line 3—3 of Fig. 1.

Fig. 4 shows a modification of the invention comprising sheets of asbestos paper or the like and means for spacing the sheets from each other.

In the various figures like reference characters denote like parts.

Figures 1–3 show a sound absorbing unit comprising a plurality of alternate layers of sheet material 1 of plane surface composited with corrugated sheets 2. The several layers are perforated in a manner adapted to admit incident sound, as at positions 3 and 4. I have used to advantage perforations that range in diameter from 0.03 to 0.06 inch, spaced on ¼ inch centers. A perforation of such size transmits sound without absorbing a large part thereof. When it is desired to decorate the outer sheet on the face of the unit that is to be exposed to incident sound, as by painting or lacquering, the perforations 4, in the outer sheet, may be somewhat larger, say, 0.2 inch in diameter, in order to avoid bridging over and closing of the holes by the decorating material.

For best results, the perforations in the several layers should be discontinuous, that is, the perforations in one layer do not register with those in an adjacent layer. When the perforations are non-registering, sound passing through the perforations is largely reflected into the spaces 5 which are defined by adjacent layers of sheet material and which extend laterally, in a direction that may be approximately parallel to the face of the unit.

The spaces may be provided with constrictions, such as barriers or other means for deflecting the sound at intervals and causing it to pass, in part, through perforations communicating with an adjacent space. The barriers or constrictions may take the form of cross-indentations or depressions 6 in the corrugated sheet. These may extend in a direction more or less at a right angle to the length of the corrugations. Preferably, the cross-indentations do not close the space entirely.

In the structures of Figs. 1–3, the spacing means which maintain the spaced relationship between adjacent layers of sheet material are the corrugations of alternate sheets.

As an alternative for the corrugations, there may be used other spacing means, as, for example, indentations or irregularities of surface other than corrugations. Also, there may be used spacing means of the type illustrated in Fig. 4, which shows sheets maintained in spaced relationship to each other by means of spacing elements comprising solid particles 8. These particles may consist of sponge, cork, or the like, suitably embedded in the various sheets of material, as illustrated.

When spacing means such as illustrated in Fig. 4 are used, there are provided irregular spaces 9 between the several layers of material in the unit.

It will be seen that the structure comprises a sound-permeable facing sheet and a sheet member of uneven surface, as for example the corru-

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gated paper described, disposed behind the facing sheet and defining therewith a space of varying thickness adapted to cause absorption of incident sound.

The material which is used in the structures of the invention is suitably a felted or sheet material that may be relatively thin and per se relatively ineffective in absorbing sound, substantially impermeable to air-borne sound, and non-vibratile, that is, not adapted to be set in vibration by incident sound. A material that is preferred at this time is asbestos paper. Other sheet material may be used, including thin sheet steel. However, steel is not a preferred material. Fabrics that are freely permeable to sound and that are in themselves sound absorbing, such as wool or mineral wool felts, may be used. The use of such sound absorbing felts, however, is not necessary, as sound may be adequately dissipated and absorbed by an acoustical block of the type illustrated, without the assistance of materials of constructions that are themselves effective sound absorbers.

The acoustical structure of the present invention may be applied to buildings in a convenient manner.

In the acoustical treatment of a room, for example, the units may be nailed, fastened in frames, or otherwise secured to the ceiling or a wall of the room. If desired, the units may be arranged so that a sheet of material of perforated plane surface is on the outer or exposed face of the unit. When a given area of the ceiling or wall is covered with such units, the units may abut at their side edges. Sound waves may pass from the edge of one unit into the spaces in an adjacent unit.

When sound strikes the perforated exposed face of the unit, it enters through the perforations. Because of scattering and also because of the discontinuity of the connection or communication between the several spaces defined by the various sheets composing the unit, the sound is well distributed in the spaces between the sheets, as in the spaces 5 or 0. As the sound travels through these spaces, it may strike barriers or constrictions such as those illustrated at 6, which cause the sound to be repeatedly deflected, in part, and to pass through the perforations into adjacent laterally extending spaces defined by other layers of sheet material in the composite. The passage through the perforations and laterally extending spaces and the deflection of the sound is repeated a great number of times. In fact, the sound may be caused to travel, in part, at least, through a course of great length, say, greater than the wave length of the sound, in a labyrinth of spaces. During this passage of sound in a course that may be of infinite length, practically speaking, a small amount of the sound may escape from the surface of the unit. However, the discontinuity of the perforations or communications and the fact that the laterally extending spaces are relatively large in area of cross section, that is, larger in cross section than the several perforations, and, therefore, offer less resistance to the passage of sound therethrough, favor the dissipation of the sound within the unit. Also, the circulation of the sound within the unit, with repeated incidence and deflection, causes the gradual destruction of the sound, by the conversion of its energy into heat.

The sound absorbing units may be fabricated in any suitable manner.

Thus, units of the type illustrated in Figs. 1–3 may be made by a method involving the process and apparatus described in U. S. Patents 1,444,395–6, issued on February 6, 1923, to Seigle. Asbestos paper is made in a conventional manner. It is then perforated, as, for example, by passage between coacting rollers, one of which is provided with short piercing pins and the other with depressions or dies which mesh with the piercing pins. After the paper is perforated, a portion of the paper is corrugated and cross-indented, as described by Seigle. Sheets of plane surface suitably including the cross-indentations described and of corrugated surface are then composited in alternate layers. The sheets may be held together by an adhesive. Thus, an aqueous solution of sodium silicate may be applied to the opposite sides of the corrugated sheets in such manner as to wet the tops of the crests and the outside of the bottoms of the troughs. The corrugated sheets with the streaks of adhesive thus applied are then adhered to alternating sheets of plane surface. This procedure is repeated until there is built a composite or block of the thickness desired.

The composited block may have various dimensions. A block may be ½ to 5 inches or more in thickness and of length and breadth suited to the installation in which the block is to be used. Thus, the block may have faces that are 1 x 1 feet, 2 x 4 feet, or of other suitable size. Perforations that may be used have been described, although it is to be understood that many other sizes and spacings may be used. The corrugations, likewise, may be of various widths or heights. Thus, the corrugations may be ⅛ inch in width, from crest to crest. There may be 5 to 10, say 8, layers each of alternating corrugated sheets having the cross-indentations described and sheets of plane surface, per inch of thickness of the block.

The modification illustrated in Fig. 4 may be fabricated by adhesively or otherwise securing together a felted fibrous product comprising spacing means and made as described, for example, in U. S. Patent 1,218,679, issued March 13, 1917, to Manville. There may be made a felted sheet, such as asbestos paper, comprising embedded spacing means, such as particles of corn cob, sponge, or the like. After these sheets are made and dried, they are provided with adhesive over the high spots and are composited to give a block of the thickness desired.

The products of the present invention are effective as acoustical units. With units 4 inches thick, of the type illustrated in Figs. 1–3, there has been absorbed 89% of incident sound of a frequency of 512 cycles per second.

The products are also effective in heat insulation. A typical block of perforated and composited asbestos sheets of plane surface and corrugated sheets weighs only approximately 11 pounds per cubic foot.

The term "perforation" is used herein to define openings adapted to transmit incident sound.

The details that have been given are for the purpose of illustration and not restriction of the invention, and many variations therefrom may be made without departing from the spirit and scope of the invention.

What I claim is:

1. An acoustical unit comprising composited sheets provided each with perforations adapted to admit incident sound and defining sound absorbing spaces extending laterally in a direction approximately parallel to the face of the unit,

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the said perforations in one layer of the said sheets being non-registering with the perforations in adjacent layers of the sheets and adapted to cause distribution of incident sound throughout the laterally extending spaces.

2. An acoustical unit comprising composited sheets provided with perforations adapted to admit incident sound and defining laterally extending spaces of relatively large area of cross section adapted to offer less resistance per unit of length to the passage of sound therethrough than offered by the several perforations, and constrictions in the spaces at intervals for deflecting sound.

3. A sound absorbing unit comprising a plurality of composited, non-nesting sheets of corrugated and cross indented paper provided with spaced perforations adapted to admit incident sound.

4. Sound absorbing means comprising composited, spaced relatively thin sheets provided severally with spaced openings adapted to admit incident sound and provided also with irregularities of surface extending between adjacent sheets and determining the spacing of the sheets from each other in non-contacting positions, the said perforations in one layer of the said sheets being largely non-registering with the perforations in adjacent layers of the sheets and the spaces defined between the sheets being adapted to absorb sound.

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