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T. B. MUNROE ET AL
SOUND ABSORBING MATERIAL

2,057,731

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FIG. 1.

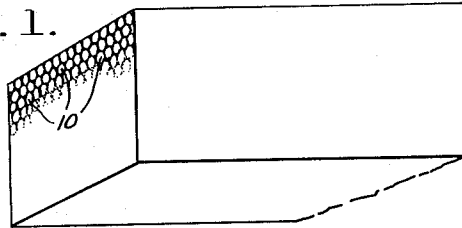


FIG. 2.

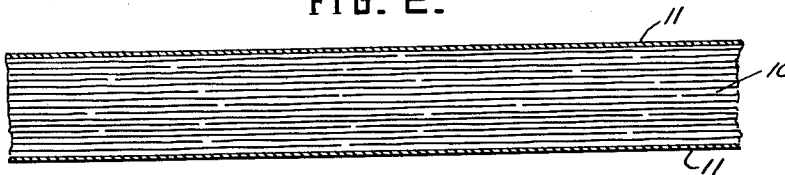


FIG. 5.

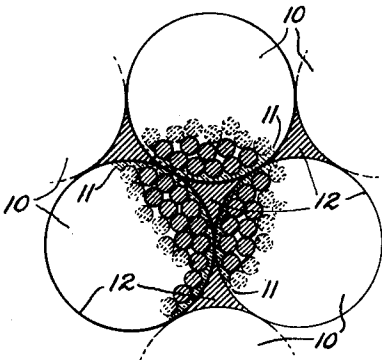


FIG. 3.

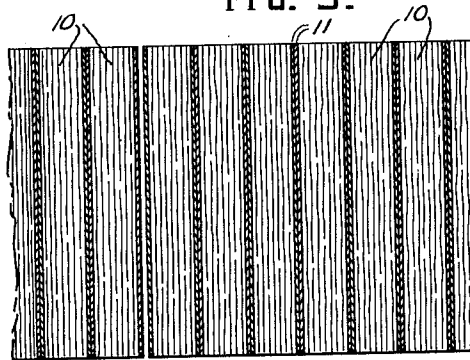
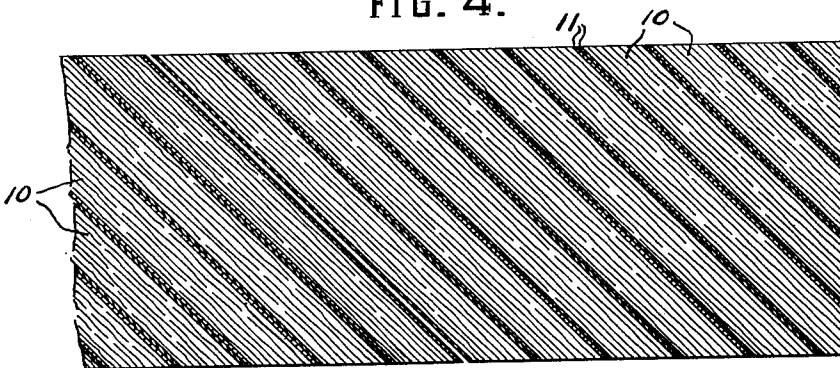


FIG. 4.



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SOUND ABSORBING MATERIAL

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Delaware

Application January 3, 1931, Serial No. 506,465

14 Claims. (Cl. 154—44)

This invention relates to a new and improved product for the absorption of sound, to be used particularly to provide acoustical correction and sound quieting in auditoriums, offices, and in the many other places where such materials are useful.

It is a fundamental of sound absorption that if the walls of an enclosure are pierced with openings of extremely small diameter that the sound waves impinging against the wall surface will enter such small openings, which, if of the proper dimensions, will through friction therein cause the decay or dissipation of the energy of the sound waves. This general knowledge has been availed of in various ways in efforts to produce sound absorbing materials to be applied to walls for acoustical correction and sound absorption, but many of the past attempts in this connection are unsatisfactory, in that either the materials are relatively unsightly or have other serious deficiencies, which have been extremely difficult to overcome.

A serious difficulty in the provision of satisfactory acoustical correction materials has been in that it has been extremely difficult to design such materials that they will have the most desirable characteristics of sound absorption, that is, whereas certain materials have been provided which are more or less satisfactory through a limited range, they have not been adaptable to universal application, and in general all such materials which have been provided have very definite peaks of absorption rather than a substantially uniform absorption throughout the full range of sounds to be absorbed.

It is particularly the object of this invention to provide an acoustical correction or sound absorbing material which comprises a decided advance over prior known materials provided for these purposes, and to produce such material, which is fire proof, or substantially fire proof, is slightly, and relatively inexpensive. Still further objects of the invention are to provide acoustical correction material which may be constructed to have either uniform absorption or to provide maximum absorption through certain ranges, and one wherein substantially all of the material of the sound absorbing product functions for the uses for which it is provided. Still other and further objects of the invention will be apparent from a consideration of the specification when considered in connection with the accompanying drawing.

In the drawing: Figure 1 is a perspective view of the acoustical correction material; Figure 2

is an enlarged detail of an element of the acoustical correction material, a portion thereof being broken away; and Figure 3 is an enlarged detail of a small section of the acoustical correction material. Figure 4 is a modified section of the material and Figure 5 is an enlarged cross-sectional view of an assemblage of said elements.

Since sound is best absorbed by means of relatively minute tubes, which structurally are practically impossible of incorporation in an acoustical correction material, they are by this invention approximated by the use of a fibrous material loosely formed into a cord or wick-like strand in which the fibers are largely disposed substantially parallel to the longitudinal axis thereof. In a cord or wick-like member as described, it is evident that there are provided throughout the length thereof numerous fine and minute openings or passages between individual fibers, which, on exposure of a face thereof comprising a cross section, will provide numerous channels substantially disposed at right angles to the face, and through which channels sound may freely enter to be dissipated and absorbed.

The cord or wick-like member designated by numeral 10, and which may, for reasons which will hereafter become apparent, preferably comprise loosely corded asbestos fiber, is preferably dipped, sprayed, or otherwise provided with a thin coating 11 of water impermeable material, such as rubber, which may conveniently be applied by drawing the cord 10 through a water dispersion of rubber, which will result in a thin film of the dispersion adhering to the exterior of the cord, which film may thereafter be dried and vulcanized as desired. Whereas it has just been stated that it is preferable that the cord 10 be coated with a rubber dispersion, this is not under all circumstances necessary, and it is comprehended that the cord may not be so coated, and also that the cord may be coated with substances other than rubber, such as, for instance, with a varnish, a synthetic resin, asphalt, or other protective film. The protective film just mentioned is provided in order that in the subsequent assemblage of these cords 10 into the complete product that they shall not be saturated with the binder employed, and the primary essential of the coating is that it shall provide protection against entry of the binder material into the cord to thereby occupy the passages or channels between individual fibers and destroy the sound absorbing properties thereof.

It was stated that an asbestos cord or wicking is preferable, and although this is in fact the

case under certain circumstances, it may not always hold true, since the primary consideration in the use of asbestos is that it is fire proof and in the event that the material need not be fire proof, other fiber substances may be substituted. In addition to the substitution of other fiber substances for the asbestos fiber particularly mentioned, it is possible that the elements may comprise non-fibrous materials, which have substantially minute pores or openings extending through the length thereof and which materials preferably are somewhat flexible rather than hard and brittle.

The elements or cord-like members 10, provided with their coating 11, are assembled in a large number in substantially parallel relation and are built up, preferably in a square or rectangular form approximately the size of the finished sheet of material which it is desired to make. The coated cords or elements when assembled are preferably much longer than the thickness of a finished element which it is desired to manufacture, since it is no more difficult to assemble elements of a length say 10 times the desired length than it is to assemble elements of a length corresponding to the thickness of the desired finished product, and whereas the latter will produce only one unit, the former may be cut across to provide, for example, ten units, if the original elements were ten units long.

The elements 10 as they are assembled may have applied thereto an adhesive, or after such elements are assembled an adhesive may be applied by a saturation obtained, for example, by submergence of the unit in the adhesive with or without being subjected to pressure or vacuum as such circumstances may be necessary for a proper impregnation or filling of the voids between elements 10 in order that they may be adhered together. The film 11 on the elements will prevent the binder from entering into the structure and is selected of substances impervious to and insoluble in the binder.

The adhesive or binder agent used may be any material which will cause the adherence of elements 10, but a rubber adhesive appears to be preferable, and especially a spongy rubber is desirable. If, as the elements 10 are laid side by side and built up into the final form, there is applied a moderately heavy film of rubber solution carrying a puffing agent, as is well understood in the rubber art, it is possible after the elements are so assembled to solidify and vulcanize this rubber, which during the vulcanizing process will, due to the formation of bubbles therein, caused by the puffing agent, produce a spongy, porous rubber binder which securely binds all of the elements 10 into the finished product. The product as just described, with a porous rubber binder between elements 10, is relatively flexible and is extremely practical in that there is no danger of breaking these elements in shipment and in their installation small inequalities in the surfaces to which they are applied are readily compensated for due to the flexibility of the finished units.

Whereas a spongy rubber binder for elements 10 has been particularly mentioned, it is to be understood that other binders may be employed, for instance, the elements 10 may be adhered together by means of a plaster film which may or may not be more or less porous, as is desired, or the binder may constitute any glue, resin, asphalt, and the like, which will adhesively and

firmly secure the units 10 in assembled relationship.

The block of material, after the adhesive has been dried, vulcanized, or otherwise solidified, may then be cut into sheets of appropriate thickness by cutting perpendicular to the axis of the cords 10, or, if desired, at some angle thereto whereby the fiber structure of the cords is exposed, thereby providing sheets or units the face of which exposes to the impact of sound waves the voids or pores between the fibers of the cords or elements 10.

Whereas the construction of sound absorbing material has been described in a particular manner, that is, its manufacture in the form of a block thereafter subdivided, it is conceivable that the material can be made in unit lengths, that is, a machine could be developed which would bunch the fibers for an element and then coat them, which coated element subsequently, in a further step, would be assembled with a binder or adhesive into the complete sound absorbing structures, and of course such methods of production of the material are comprehended. The specific manner of production of the sound absorbing material, as particularly described in the specification, is that at present considered to be the preferred embodiment of the invention, which is, broadly stated, the provision of a self-sustaining sheet-form sound absorbing material comprising longitudinally porous elements adhered to form a sheet-like material which presents a sound porous or sound wave pervious face.

The sound absorbing material may be used in combination as a facing material for other sound absorbing substances which, though functionally efficient for the absorption of sound, are not, for one reason or another, mechanically satisfactory. For example, the material of the invention, utilized as a facing for a mineral wool felt, provides a sound pervious facing which is also sound absorbing and which freely passes the residual sound energy not absorbed in the facing material to the rock wool felt, wherein such residual sound energy may be further dissipated.

The appearance of this sound absorbing material is pleasing, as it presents a somewhat regular but not geometrically accurate face, comprising irregularly arranged generally circular elements spaced and interwoven with filaments of the adhesive or connecting substance which holds the structure together. The cords or elements 10 may be the same color or may contrast with the color of the binder, and by a judicious use of dyed or stained cords and colored binders, quite pleasing decorative effects may be obtained.

In the manufacture of relatively small units it is not absolutely essential that the distributed binder be used, that is, the binder may be an element surrounding a group of the sound absorbing elements or cords 10 to secure them as a bundle. If the elements are of a nature such that they may be sustained from an end, they can be adhered at one end to a relatively rigid backing sheet with, if desired, a further retaining means comprising a tie or binder of some sort peripherally surrounding a relatively large group of the elements 10. In the specification, the words "binder" and "adhered" are, in the sense employed, meant to denote broadly the means securing a plurality of the sound absorbing elements 10 in assembled relationship.

On consideration of the above description of the invention, it is believed to be fully apparent that there has been described the construction of a sound absorbing material which has not only the desired characteristics as pointed out in the statement of the objects of invention but which in addition has various other and further advantages over sound absorbing materials heretofore produced or contemplated.

While it has not been specifically so stated, it should be readily apparent to those skilled in the art to which this invention appertains, that the amount and degree of absorption of sound by the described material may be readily varied within any practical desired limits. The size, that is, particularly the diameter of the cords or elements 10, may be varied, the size of the pores or passages in the elements 10 may be varied by the use of elements composed of fiber of larger or smaller diameter; and of course the material may be cut or formed of varying depth, all of which variations, as is understood, causing variation in the sound absorbing properties of the finished sound absorbing material.

We claim:

1. Sound absorbing material, a face of which is exposed for impact by sound waves, comprising wick-like fibrous elements assembled into a sound absorbing unit, the porosity of the elements substantially continuous and extending from the face, adapted to be exposed, to the back of the sound absorbing material.

2. Sound absorbing material comprising relatively loose strands of fibrous substance, the strands coated with a relatively moisture resistant substance and subsequently adhered together in substantially parallel relation, the strands extending through the thickness of the material.

3. Sound absorbing material comprising strands of fibrous substance, the strands coated with a relatively moisture resistant substance and subsequently adhered together in substantially parallel relation extending through the thickness of the material, the substance adhering the units together being relatively cellular and porous.

4. Sound absorbing material comprising elements having a length at least as great as their widths, the elements pervious to sound waves for substantially their entire lengths and adhered together in substantially parallel arrangement extending through the thickness of the sound absorbing material with a sound pervious end face of each element, comprising substantially only fiber ends, exposed and forming a face of the sound absorbing material.

5. Sound absorbing material comprising loosely stranded fibrous asbestos, the individual strands coated with rubber and subsequently assembled in block form, the strands substantially parallel to one another and extending through the thickness of the material.

6. Sound absorbing material as defined in claim 5 comprising sheets formed by severance of the block across the axes of the strands.

7. An acoustical correction material comprising an assemblage, in substantially parallel relation, of elements pervious to sound waves, and

presenting a sound wave pervious section for impact by sound waves, the individual elements of a relatively open porous construction and having minute passages or pores extending generally longitudinally thereof and in effect continuous, the face of said sound wave pervious section comprising the major area of the sound impacted and sound pervious exposed face of the material.

8. An acoustical correction unit comprising a plurality of elongated sound absorbing elements adherently united, wherein the sound absorbing elements are arranged in substantially parallel arrangement extending through the thickness of the unit, and at the face thereof, comprising substantially only fiber ends are open to and permeable by sound waves impacting there-against.

9. A sheeted fibrous material for acoustical correction purposes, the fibers extending axially in the direction of the thickness of the sheet, as distinguished from the usual sheeted fibrous materials wherein the fibres are either in heterogeneous felted arrangement or axially extend in either or both the direction of the length and breadth of the sheet, the fibers thereof bound in groups by thin longitudinal encasements.

10. A fibrous sound absorbing acoustical correction sheet material composed of fibrous substance and having finite thickness and wherein the fibrous substance extends generally in the direction through the thickness of the sheet material, the fibrous substance reinforced with means interspersed within and throughout the fibrous sheet material to maintain the fibrous substance in its position therein.

11. Acoustical correction material, a face of which is exposed for impact of sound waves, wherein the material is of sheet form composed of lengthwise ensheathed wick-like fibrous and porous elements assembled and bound into sheet form, the porosity of the wick-like fibrous elements extending from the face of the material adapted to be exposed substantially continuous through the thickness of the sound absorbing sheet.

12. Sheet form acoustical material comprising an assemblage of individual reinforced elements, arranged side by side in substantially parallel arrangement, extending through the thickness of the sheet and bound together in such sheet form, the individual elements thereof comprising sections of material having substantially continuous longitudinal porosity extending from an end face through the length thereof.

13. A sound absorbing material comprising a sheet form base material having open cells extending through the thickness thereof, the cells having therein longitudinally arranged porous material having substantially continuous porosity longitudinally.

14. A sound absorbing material comprising a body having open cells extending from the face thereof adapted to be exposed through the thickness thereof and a sound absorbing filler in such cells composed of strands having substantially continuous porosity longitudinally.

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