

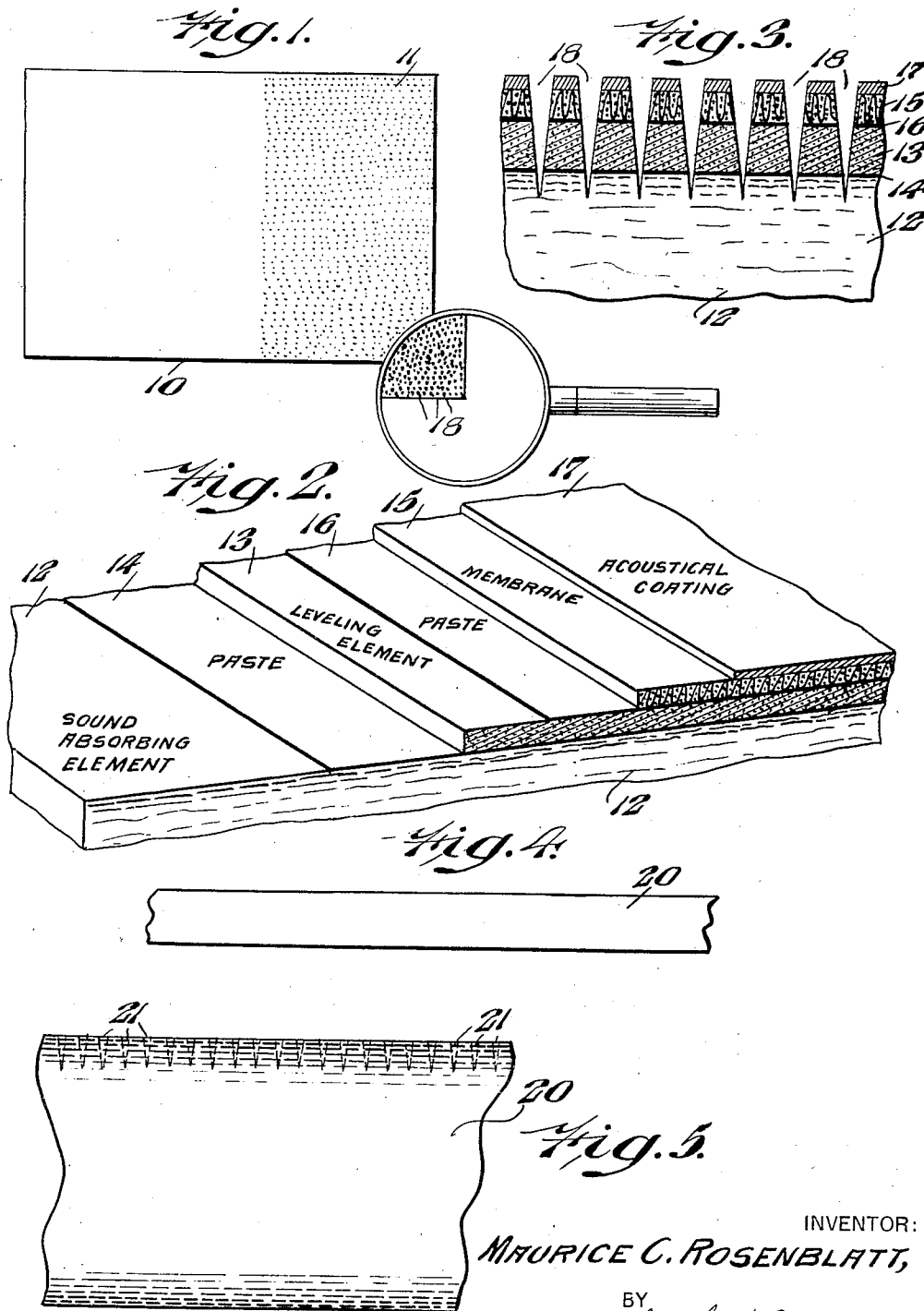
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ACOUSTIC TREATMENT

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ACOUSTIC TREATMENT

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This invention relates to acoustic treatments.

Among the objects of the invention are; to provide a method for increasing the sound absorbing efficiency of acoustic treatments; to provide a method for regulating and controlling the sound absorbing efficiency of acoustic treatments; to provide an additional step in methods of treating surfaces acoustically to increase the absorption of an area subjected to the step; to provide a method of improving the sound absorptive factor of acoustic treatments without adversely affecting the superficial visual aspect thereof; to provide an acoustic treatment susceptible to cleaning and washing but with a relatively high coefficient of sound absorption; to provide an improved acoustic treatment generally, and many other objects and advantages as will be more apparent as the description proceeds.

The invention consists in the provision of a multiplicity of minute pores or openings in the outer surface of the acoustic treatment; and, further, to the utilization of the porosity thus effected with acoustic materials and others, to form a novel acoustic treatment.

In general there are two practical methods or treatments for securing the absorption of impinged sound waves, or a more or less limited proportion thereof, in use in the art. That known as the non-contact membrane type, in which a membrane is stretched in spaced relation to a concealed layer of absorbent material, and which is rather expensive and requires skilled workers; and the contact membrane type, in which the covering membrane is in contact with the concealed absorbent element. This latter type is more frequently used owing to the relatively less skilled workers necessary, and also because of the trend toward texture finishes on the surfaces of walls and ceilings. With the contact membrane acoustic treatment, in which an absorbent material such as felt, for instance, has an imposed membrane pasted or cemented to it, the membrane follows generally the contour of the rough surface of the felt, and when the membrane is painted or otherwise coated, the superficial aspect

of the treatment is as of rough plaster. This effect is not undesirable at the present time, indeed, as noted, it comports with the trend of architectural interior finishes.

In treating a given room or auditorium for acoustic deficiencies, the ceiling is usually the first point of attack, and if treatment of the ceiling alone does not provide the desired amount of absorption, then the walls may also be treated. Circumstances, of course, may alter the order of treatment, but in general the painted or coated contact membrane type of acoustic treatment upon a ceiling is fairly efficient as to its sound absorbing efficiency, and is also rather pleasing to the esthetic senses. It is to be noted, however, that in any case the exposed membrane is painted or coated in order to make the treatment acceptable from an ornamental standpoint. Unfortunately this coating effects a sharp reduction in the efficiency of the treatment as a whole. This is for the reason that the coating, be it paint, either with or without oil, thin plaster, or whatever else may be used fills in the pores of the membrane and forms a skin which is more or less reflective of sound waves incident thereon. The more reflective the surface of the coating the lower the absorptive efficiency of the treatment.

Much effort and expense have been expended in an effort to find a coating material which provides a good finish, but which has such porosity as to permit the penetration of sound waves to the absorbing material beneath or behind it. So far as known this has not been effectively accomplished in the coating itself.

The invention herein, contemplates the coating of an acoustic treatment with a durable and effective coating, then permitting the coating to dry, preferably, then by some mechanical means making the coating porous or pervious to sound waves without affecting the appearance or other properties of the coating. For certain purposes also, the invention contemplates the formation of a multiplicity of minute pores or openings through the coating and into the absorbent material itself to effect a more efficient sound absorbing whole. This latter phase of the inven-

tion is of particular value in connection with acoustic material other than felt, where perchance the porosity of the material is not as great as it may be made by this invention.

In the accompanying drawings,

Fig. 1, represents a plan of an acoustic material or treatment, in which the stippled portion represents an area containing a multiplicity of minute artificial pores enhancing the absorption of the area, and the portion bounded by the circle indicates a slightly magnified area,

Fig. 2, represents a detailed perspective of a form of acoustic treatment susceptible to improvement of the absorptive value by the invention herein,

Fig. 3, represents a fragmentary section on a greatly magnified scale of an acoustic treatment as shown in Fig. 2, with the minute artificial pores of the invention formed in the outer surface and penetrating to the main sound absorbing element,

Fig. 4, represents a side elevation of a fragment of a commercial composition board of limited sound absorbing power, and

Fig. 5, represents a side elevation of the same on a greatly magnified scale, showing the formation of the multiplicity of artificial minute pores in dotted lines in the surface thereof.

By the term "acoustic material" is meant material having certain characteristics rendering it available for use in the solution of acoustic problems. The usual requisite is that it have the capacity to absorb more than a minimum of percentage of incident sound waves. When such material, either alone, or in combination with other materials, is applied to the structure of a building, thereby correcting an acoustical defect therein, it is known as an "acoustical treatment." As noted the invention herein is applicable to the material and to the treatment.

A given portion of an acoustical treatment, such as 10, may be one in which it is desirable to increase the sound absorbing efficiency of a part only, as 11. According to the invention, therefore, this latter area may be filled with a multiplicity of minute artificial pores 18, formed in the exposed surface of the treatment. While the minute pores of this invention may be utilized in connection with any form or type of acoustical treatment, substantially, yet it is of particular value when the treatment has a reflective and non-absorbent coating or layer, or a plurality thereof, such as is almost always present, and which invariably reduces the sound absorbing efficiency of the treatment. In constructing or forming acoustic treatments, it is usually necessary to use one or more non-absorbing layers, such as layers of paste, or glue, paint, etc., and although such layers are made as thin as possible for the

purposes intended, yet they do effect a sharp reduction of the sound absorption of the treatment. In the drawings there is illustrated an acoustic treatment having an initial absorption of value, but which absorption may be materially increased by the invention herein.

The treatment comprises an inner layer of sound absorbing material 12, such for instance as felt or composition material, to which a relatively thin leveling layer of felt 13 may be joined by a layer of paste or glue 14. This leveling layer is not essential, of course, but it is helpful in securing a smooth external finish for the treatment. Upon the leveling layer 13, a membrane 15 may be placed and joined to the leveling element by a layer of paste or glue 16. A coating 17, as of paint, enamel, thin plaster, etc., may be applied to the outer surface of the membrane to impart an attractive finish to the treatment. The treatment just described has considerable value in the art, and forms the subject matter of Patent #1,671,208, issued May 29, 1928, to Maurice C. and Stanley H. Rosenblatt.

Although this treatment, for numerous reasons, is of value in acoustic work, yet it will be noted that there are three layers in the treatment which are reflective and non-porous, each of which reduces the sound absorbing efficiency of the treatment. It will be clear that under various circumstances the composition of the treatment may be varied so as to reduce the number of non-porous layers, but even one layer effects a diminution in the absorption. Thus the final coating alone is disadvantageous from the standpoint of maximum absorption, although usually necessary from an ornamental standpoint.

It is contemplated that such acoustic treatments, and others, may have a multiplicity of minute pores 18 formed mechanically in the surface thereof. Each pore 18 is of such minute area as to be visually insignificant and relatively unnoticeable, and of itself to conduce but little, possibly, to the enhancement of the absorption. In the aggregate, however, a multiplicity of the pores, provides an appreciable pore area.

The pores 18 each comprise a tapered or conical hole of substantially identical diameter, and they are preferably closely grouped but evenly spaced in the area. It being understood that the factor in an acoustic treatment of material contributing to the absorption of sound is intercommunicating pores in which portions of the sound waves are trapped and their energy translated into another form, as into heat. Each coating, such as those disclosed, closes the surface pores normally or initially present in the treatment of material, preventing the dissipation of any appreciable portion of the sound energy

through the intercommunicating pores of the treatment beneath the non-porous coating. It will be understood, moreover, that the efficacy of the invention herein is not dependent upon the pores alone, except as they extend into communication with sound absorbent material, and form passages leading into intercommunicating pores within the treatment.

It is of interest to note that the formation of the multiplicity of minute artificial pores may be made long after the treatment has been initially installed, so that the invention may be availed of to correct acoustic treatments after their installation.

The invention is not only applicable to treatments after attachment to structural elements as disclosed, but is also available and highly useful to improve the sound absorptive power of acoustic materials, as a step in the finishing method or process of fabrication. There are numerous fibrous composition boards or sheets of material, made of waste and by-products of other industries, and other materials, which are highly desirable for their workability, economy, etc., and which have an initial sound absorption of value, but which can be enhanced at very slight cost by the invention herein.

Such a material is shown in Figs. 4 and 5, and comprises a sheet of artificial composition material, such as 20, possessed of sufficient absorption value as to be deemed an acoustic material, but possibly only from force of necessity owing to other advantages such semi-rigid workable materials possess. These materials are usually fibrous and have series of intercommunicating pores in the structure, but owing to the processes of manufacture the fibers are found to lie substantially flat in the board, in planes parallel, substantially, with the surfaces thereof, and as an incident to the rolling or other compression factor in forming the sheets, present a compacted mass of flat lying fibers at their flat edges or flat surfaces, that is the surfaces of greatest area. If the sound waves could penetrate with more ease into the board 20, the sound absorption would be greatly enhanced, as the matted compacted surface presents a somewhat reflective, and possibly non-porous surface precluding the transmission of sound energy beneath the surface and into the intercommunicating pores. Clearly the board 20 is not non-porous in the strict sense, but the porosity is a minimum. As shown in Fig. 5, the pores 21 extend through the congested and matted surface into the relatively softer, more absorbent material immediately beneath the surface. As in the finishing step for the treatment, the pores are each visually insignificant, but in the aggregate provide appreciable pore area facilitating the passage of sound waves into the intercommunicating

pores of the material, and in the aggregate remaining visually insignificant, so as to effect no substantial visual change in the aspect of the material.

In forming a multiplicity of minute pores or openings in the coating or membrane or both, or the coating and the concealed acoustic material upon which it is superposed, it is preferred that mechanical means be utilized, and the form of mechanical means that may be assumed varies according to the desire of the operator. It has been found that desirable results may be had by providing a manually or otherwise actuated roller, studded with a multiplicity of sharp thin points projecting preferably radially, and with the tips or points a very slight distance from the surface of the roller. It will be clear that subjecting the treatment to a rolling action will cause the tips of the points to extend into the coating, and if desired according to their length, into the acoustic material of the treatment. It may be made in the form of a vibrator containing numerous closely grouped points embedded in live rubber, the vibrator head may be operated, for instance by a small throw cam on a flexible shaft operated by a small high speed electric motor. Another possible form is a flat plate studded with points, with a spring and trigger arrangement to cause the plate to be depressed slightly, and then released by the trigger to strike the acoustical treatment. With this latter form a clock spring may be incorporated to strike a succession of blows. Or the perforations may be made by hand with a studded hand piece.

In any case, whatever the form assumed by the piercing mechanism, and the exact structure used to attain the result is immaterial to the present invention, the effect is the piercing of the skin coating and the membrane, and if desired, the acoustic material itself, according to the length of the pins or points used, with a multiplicity of closely grouped perforations or pores, each of itself of minute area, but which in the aggregate provide such porosity as materially to increase the absorptive factor of the treatment.

The exact figures and proportions used may vary within wide limits, but it has been found, and will be cited for illustrative purposes, that a certain acoustic material such as a certain thickness of felt has an absorptive efficiency of 40%. When a coated membrane is imposed upon the felt, the efficiency may be 22%. Using points of approximately one/one hundredth of an inch in diameter, and spaced on centers one/thirty-second of an inch apart, it is possible to provide as many as 150,000 pores in a square foot of surface. Each pore is minute and is practically undiscernible to the eye, but the area of the pores in the aggregate is very appreciable.

5 ciable indeed. With the figures given, approximately 13% of the area treated is pore area, through which sound waves may pass to the acoustic material behind. It is found
10 that the efficiency of the felt, which is 40% is reduced to 22% when the reflective coating is applied. It is found that when the step of forming the pores as recited is consummated, the 18% reduction of efficiency accounted for by the coating becomes only
15 13.8% when pierced, so that the net efficiency of the completely treated surface is raised to 28.2%, an appreciable and valuable increase.

Of primary importance in the use of the invention is the fact that by this method the
15 acoustical value of materials may be regulated or controlled. Thus the efficiency of the material can be increased at one place to a higher point than another place. For instance, assuming an auditorium requiring
20 treatment to reduce reverberation as well as to minimize discrete echo from an offending surface, or the focusing of sound by a curved surface, the offending surface may be treated
25 as above to effect a higher unit absorption.

For noise quieting treatments this method may be used to produce a greater effect and higher unit absorption.

Of additional importance also is the fact
30 that with the method of surfacing recited, the coating material may now be a washable coating, such as paint, enamel, etc., and thus enable effective acoustic treatment to be applied in hospitals, and similar institutions,
35 where the sanitation and washability of the walls is a paramount consideration.

In adapting an acoustic treatment to this latter purpose, the coating which as in any other acoustic treatment may be preformed
40 upon the membrane, instead of applied thereto subsequently, may be enamel which is normally water-proof, and, of course, sound reflective. When the acoustic treatment in this latter case is in position, and
45 the multiplicity of minute pores is formed in the membrane, the efficiency of the treatment is enhanced to a point where the treatment is efficacious, but the treatment may still be washed when desired, as the apertures
50 or pores are of such small diameter that a film of water forms over each which will dry out in a short time without penetrating to the acoustic material beneath.

An important aspect of the invention is
55 that certain acoustic materials, such as composition boards, which are easily and cheaply worked, but which have a fairly rough exterior, may be coated directly with a thin coat of plaster, and then while still moist, the multiplicity of minute pores of this invention
60 may be formed in it before the plaster sets, to provide a fairly efficient acoustic treatment. The effect visually is of rather smooth plaster, the pores being fairly undiscernible, except possibly at very short range.

It is to be noted further that the step in the process recited may be an independent one in the application of acoustic treatments. That is the process of providing the complete acoustic treatment need not be a continuous succession of steps. There may be a perceptible time interval between parts of the process. Thus with the invention herein recited, the problem may be the bare increase in the efficiency in absorption, of an old acoustic treatment. The invention is perfectly available for this purpose, and by rolling in, or otherwise forming a multiplicity of minute pores in the old acoustic treatment, the efficiency of the treatment can be increased as indicated. This is an economical procedure, as it frequently saves the larger cost of additional acoustic treatment upon other exposed surfaces of the room, such as might otherwise be necessary to secure the efficiency necessary for the problem.

It will be clear that in forming the pores it is contemplated that they pass through the coating, the membrane, and the stiffer layer of paste or glue by which the membrane is caused to adhere to the backing material, if necessary.

There are a number of fibrous, semi rigid composition materials now before the public which have value in certain forms of acoustic treatments, as they have fairly high absorptive properties, and due to their nature can be used in many places to advantage. The invention recited herein is to be considered as applicable to such materials for the increase in absorption of the materials, whether coated or not, and whether carrying an imposed membrane or not. The formation of a multiplicity of minute pores in the surfaces of such materials supplements and augments the natural porosity of the material, so that a higher absorptive efficiency is available than the normal material can provide. Further it renders available for acoustic purposes sheet materials that would ordinarily be unavailable for such purposes by increasing the absorptive efficiency of the material to an available point.

I claim as my invention:

1. A step in an acoustic treatment process that consists in mechanically forming a multiplicity of substantially identical visually insignificant surface piercing pores in an otherwise relatively non-porous surface of acoustic material.

2. A method of treating a surface acoustically that consists in applying acoustic material to the surface, coating the exposed surface of the material, permitting the coating to at least partially dry, then mechanically forming a multiplicity of minute pores in the surface of the coating extending through the coating to communication with the material.

3. A method of forming a washable acoustic surface which consists in applying acoustic

material to a surface, or area, then applying a washable coating to the material, then mechanically forming a multiplicity of minute pores in the coating extending through the coating to communication with the material, each pore being of such reduced diameter as to admit a portion of an impinged sound wave but to exclude liquids.

4. An acoustic process which consists in the fabrication or application of an acoustic material having an absorbent portion comprised of series of intercommunicating pores, and having a relatively thin film or layer in juxtaposition to the absorbent portion tending to preclude the transmission of imposed sound waves into the absorbent portion, then in forming a multiplicity of minute artificial pores in the thin layer, each pore being visually insignificant and of such depth substantially as merely to pierce the thin layer and communicate with the intercommunicating pores of the material.

5. An acoustic treatment for hospital walls including a layer of acoustic material, an imposed membrane, a coating of washable material imposed on the membrane and being initially substantially imperforate, the coating and membrane having a multiplicity of surface piercing inwardly extending pores, each of such minute area as to be substantially impervious to liquids, but pervious to portions of impinged sound waves.

6. An acoustic material having an inner absorbent stratum of material and an outer more dense and compacted stratum of material, the outer stratum having a multiplicity of visually insignificant substantially identical minute pores artificially formed in the exposed surface thereof and extending there-through to communication with the inner stratum.

In testimony whereof, I affix my signature.
MAURICE C. ROSENBLATT.