

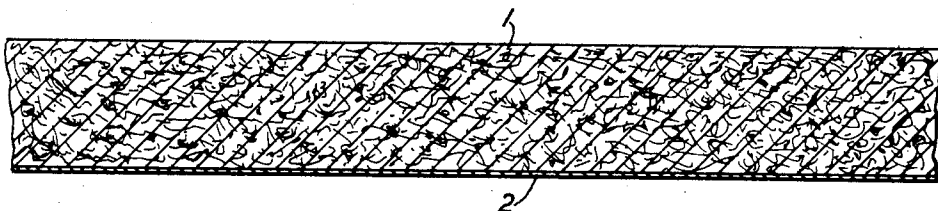
Jan. 21, 1936.

H. D. ARNOLD

2,028,180

ACOUSTIC MATERIALS

Filed Sept. 18, 1930



INVENTOR

H.D. ARNOLD

BY

J. M. Campbell

ATTORNEY

UNITED STATES PATENT OFFICE

2,028,180

ACOUSTIC MATERIALS

Harold D. Arnold, Maplewood, N. J., assignor to
Bell Telephone Laboratories, Incorporated,
New York, N. Y., a corporation of New York

Application September 18, 1930, Serial No. 482,678

2 Claims. (Cl. 154-44)

This invention relates to the acoustic treatment of walls or partitions of rooms such as sound picture studios and is a continuation in part of my application, Serial No. 248,332 filed January 21, 1928.

The present invention has for its object to provide for substantially uniform absorption of air wave energy over a wide range of frequencies such as those produced by speech and music.

To reduce reflections and reverberations it has been customary to surface a room with a thick porous material—one of rather loose texture of low density and easy to compress, with low elastic constant and high internal friction. For purposes of convenience, such material is used in thicknesses ranging from a fraction of an inch to a few inches; usually, however, practical considerations limit the thickness to the order of an inch or less.

As is well known, sound waves in air are compression waves in which the air moves forward and back with a variable velocity and between limits determined by the wave-length or frequency of the sound wave. In the case of sounds with the frequency of 100 cycles per second the wave-length is approximately 11 feet; whereas in the case of sounds of 10,000 cycles per second the wave-length is only a little more than 1 inch. The action of the sound absorbing material is to abstract energy from the sound wave either by the internal friction of its own loose structure when moved back and forth by the sound wave, or by the friction between the air itself and the material as the air is driven in and out of its porous structure.

It is desirable to have an acoustic material which will abstract the same percentage of its energy from any sound wave no matter what its frequency. That this is not accomplished by materials such as felt, Celotex, and others commonly used, is plainly evident upon entering a room surfaced with these materials. Such rooms give a sense of oppression which careful analysis shows is due to the undue absorption of high frequency sound waves. This results in too great a relative emphasis of the low pitched sounds with a loss of that clearness and sharpness of acoustic effects which require the retention of high frequencies. The reason for this undesirably large relative absorption of high frequencies is that the materials as used are so thin in comparison with the large extent of movement in low frequency sound waves, as described above, that they are not very effective in abstracting energy from such sounds. This relation is, however, enormously

different with reference to very high pitched sounds and hence they are more effective as absorbers of these latter sounds.

Attempts to correct this situation and provide a better absorbing material might follow either of two lines, one of which would be to make the material a better absorber of low frequencies. This, however, would entail an abnormal increase in the thickness of the material used or a change in its internal structure and is not attempted here. The other is to provide a structure in which the absorption of sound energy at the high frequencies is reduced until it is comparable with the absorption at low frequencies. It is my invention to accomplish this by applying to the exposed surface of the absorbing material a thin, non-porous layer of high density material. This allows the thick mass of the absorbing material proper to compress and expand with the low frequency sound waves, thus abstracting energy from them by its internal friction. It does not, however, allow such movements to a corresponding extent with high frequency sound waves, since their reflection will be determined to a large extent by the heavy surface they first meet and through which they cannot so readily communicate.

Experiment has shown that the addition of such a thin dense coating to the surface of a sound absorbing material such as Celotex or felt does effectively decrease the absorbing power at high frequencies without making such a substantial reduction at low frequencies and therefore produces a more uniform coefficient through the entire frequency range.

An efficient proportion is obtained when the exposed surface layer has a thickness 2% or less of the main absorbing body and a density 3 to 5 times as great as that of the main body. While these proportions operate to advantage it may be stated as a general principle that the surface layer should be as dense as possible. A layer of gold foil of the order of 1/100 of an inch thickness would be very excellent but is obviously impracticable. A more practical method is to coat the surface of the absorbing material with a plastic or liquid surfacing which "sets" to a hard, firm surface. Paint or enamel compounded with a heavy base, or a very thin layer of cement or plaster, are practical mediums for realizing the desired advantages.

In the drawing which is a sectional view of a wall covering made in accordance with my invention, 1 represents a thick, porous and easily compressible layer of low density material such

as felt and 2 a hard, smooth surface which for practical purposes may comprise a thin coating of paint or enamel applied in liquid form and permitted to set. It is obvious from the previous discussion however, that the invention is not to be limited to any specific material for the exposed surface so long as it comprises matter of sufficient resistance and is not too great a proportion of the total thickness.

10 What is claimed is:

1. A partition or wall covering for the acoustic treatment of rooms comprising a thick, porous and easily compressible layer of low density material adapted to readily absorb energy from air waves of the lower frequencies, and an exposed,

thin layer of high density non-porous material covering the porous material to prevent excessive absorption of energy from air waves of the higher frequencies.

2. A partition or wall covering for the acoustic treatment of rooms comprising a thick porous material such as felt adapted to absorb energy from air waves of the lower frequencies and an exposed thin layer of high density non-porous material such as paint or enamel covering the porous material and adapted to prevent excessive absorption of energy from air waves of the higher frequencies.

HAROLD D. ARNOLD. 15