May 9, 1933. E. H. BEDELL 1,907,712

ACOUSTIC DEVICE

Filed March 11, 1932

FIG. 1

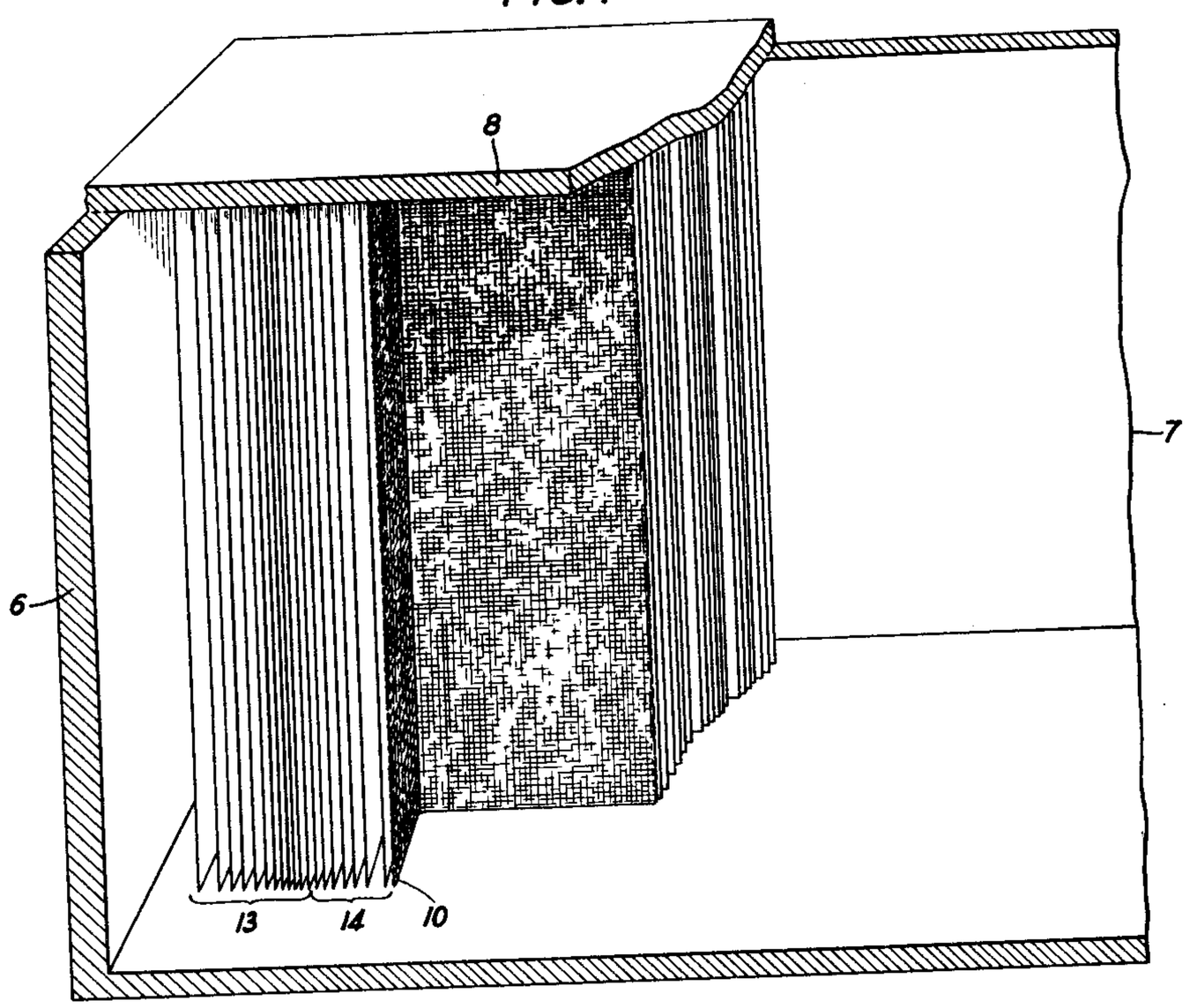


FIG. 2

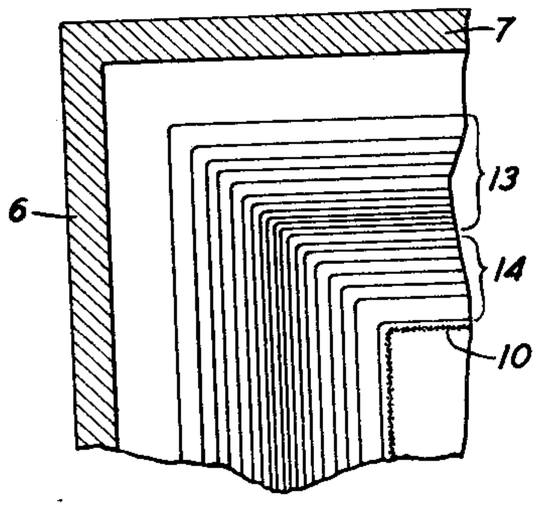


FIG. 4

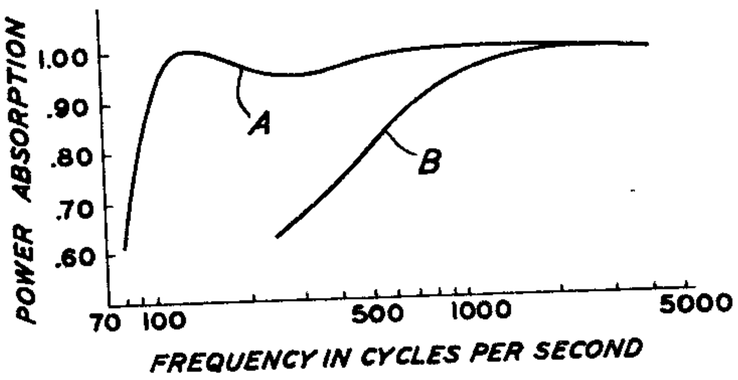
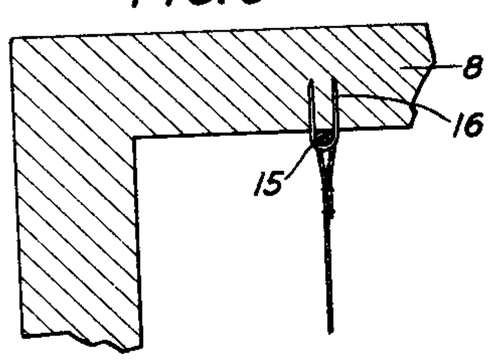


FIG. 3



INVENTOR
E. H. BEDELL
BY
ATTORNEY

Patented May 9, 1933 1,907,712

UNITED STATES PATENT OFFICE

EUAL H. BEDELL, OF SUMMIT, NEW JERSEY, ASSIGNOR TO BELL TELEPHONE LABORATORIES, INCORPORATED, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK

ACOUSTIC DEVICE

Application filed March 11, 1932. Serial No. 598,117.

This invention relates to sound absorbing structures for controlling the acoustics of studios, sound chambers and the like.

An object of the invention is to provide a sound chamber having reverberation time approximately constant with frequency.

Another object of the invention is to provide a sound absorbing structure which has a high and substantially uniform absorption coefficient for all frequencies above 100 cycles per second.

Heretofore the sound absorbing materials used for damping walls have been comparatively close grained with the result that the surface reflection has been considerably greater for low frequencies than for high frequencies. In order to absorb more of the energy at low frequencies, it has been the practice to mount the absorbing material with an air space of several inches between it and the wall or walls of the studio or chamber. While this arrangement increases the absorption at the low frequencies, it introduces resonance effects which cause irregularities in the absorption.

Specifically the invention provides a multiplicity of layers of unequally spaced partitions of cloth or other suitable acoustic material the minimum spacing between partitions being approximately one half inch and the total thickness of the structure being approximately one quarter the wave length of the lowest frequency to be absorbed.

Referring to the drawing:

Fig. 1 represents a fragmentary perspective view, with the ceiling removed, of one corner of a studio or a room treated with sound absorbing material in accordance with the invention;

Fig. 2 is a detailed sectional view through a corner;

Fig. 3 is a detailed view showing the method of supporting the sound absorbing material; and

Fig. 4 shows the power absorption versus frequency characteristic of the sound absorbing material in accordance with the invention.

In front of the walls 6 and 7 of an acoustic studio are hung, or otherwise suitably supported, a plurality of layers or walls of fabric, or other suitable sound dissipative material, spaced parallel to each other at unequal distances to form a sound absorbing member of considerable thickness, as for example, approximately three feet, or approximately one quarter the wave length of sound at 100 cycles per second.

As shown on the drawing there are nineteen layers, or walls of fabric. The twelve layers 13 nearest the walls of the room are preferably of canton flannel having a mass of approximately .017 grams per square centimeter and an acoustic resistance of 12 ohms per square centimeter and the seven inner layers 14 are preferably of muslin having a mass of .013 grams per square centimeter and an acoustic resistance of 6 ohms per square centimeter. These sheets of fabric may be supported from the ceiling on rods 15 and staple fasteners 16. Similar means may be used at the bottom of the sheet.

As shown on the drawing the spacing between the seven outermost layers 13 decreases towards the wall and the spacing between the twelve innermost layers 14 increases towards the wall thus providing a very effective dissipating acoustic network in which the mass and the resistance of the material are series elements and the stiffness or elasticity of the chambers are shunt elements. The acoustic resistance of the material should be as high as possible as compared with its mass reactance and the stiffness reactances or impedances of the chambers should be such as to substantially compensate for the mass reactance of the material for frequencies above one hundred cycles per second to provide a uniform absorption above this frequency. In order to reduce the fire hazard of a damping structure of this nature the layers may be treated with a suitable fire resistant compound and a wire netting 10 may be placed in front of it.

The power absorption as shown in curve A of Fig. 4 is practically unity for frequencies above 100 cycles. Curve B shows for the sake of comparison the absorption power of other commercial sound damping material.

A studio or room damped in accordance

with the invention has substantially the same reverberation period for all frequencies of importance in music and speech on account of the uniform sound absorption characteristic. In view of this uniformity of sound absorption the liveness of a room or studio damped in accordance with the invention may be controlled quite accurately by arranging sound reflecting surfaces therein.

What is claimed is:

1. A sound absorbing structure comprising a multiplicity of substantially parallel sheets of cloth spaced to form a plurality of chambers therebetween and having a substantially uniform sound absorption for all frequencies above 100 cycles per second.

2. A sound absorbing structure comprising a multiplicity of spaced cloth partitions unevenly spaced to form chambers therebetween of unequal volume and having a total thickness of approximately one quarter the wave length of the lowest frequency to be absorbed.

3. A sound absorbing structure comprising a multiplicity of layers of cloth unequally spaced, said layers having different acoustic resistances and different masses.

4. A sound absorbing structure comprising a multiplicity of layers of cloth unequally spaced, the space increasing in each direction from an intermediate layer.

5. A sound absorbing structure comprising a multiplicity of layers of cloth spaced to form acoustic chambers therebetween and an outside protecting screen of metal.

6. In a sound absorbing structure an acoustic network comprising a plurality of substantially parallel spaced thin sheets of sound penetrable material forming a plurality of chambers, the accoustic impedance of said chambers and said layers being such that the power absorption of said network is practically unity above 100 cycles per second.

7. An accoustic studio having walls comprising a plurality of spaced parallel thin sheets of sound penetrable material having an acoustic resistance high as compared with its mass reactance.

8. A sound absorbing structure comprising a plurality of thin sheets of sound penetrable material separated to form acoustic chambers therebetween, said sheets having different masses and different acoustic resistances.

9. A sound absorbing structure comprising a multiplicity of thin sheets of sound penetrable material separated to form acoustic chambers therebetween, said sheets having high resistance as compared with their masses and said chambers having such stiffness as to substantially compensate for the mass reactance of said material for frequencies above one hundred cycles per second.

In witness whereof, I hereunto subscribe my name this 9th day of March, 1932.

EUAL H. BEDELL.