Aug. 15, 1939. J. S. PARKINSON 2,169,370

SOUND ABSORBING ARTICLE

Filed Dec. 19, 1936

Fig. 1.

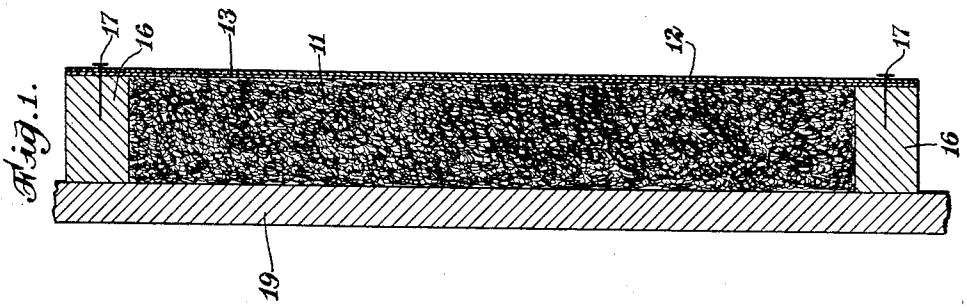
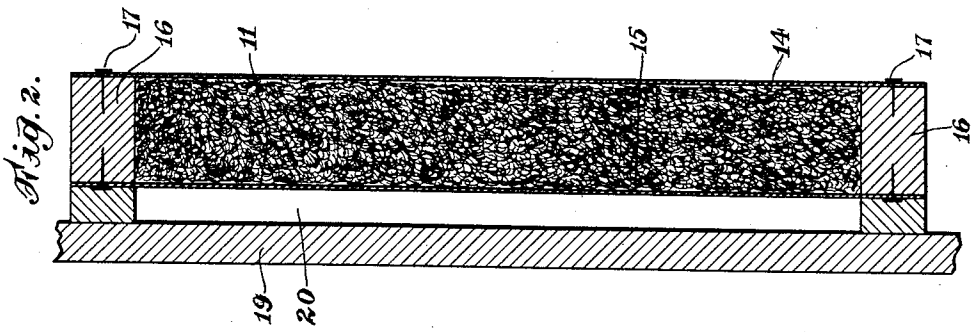


Fig. 2.



INVENTOR
John S. Parkinson.
BY
Virgil C. Kline
ATTORNEY

Patented Aug. 15, 1939

2,169,370

UNITED STATES PATENT OFFICE

2,169,370

SOUND-ABSORBING ARTICLE

John S. Parkinson, Somerville, N. J., assignor to Johns-Manville Corporation, New York, N. Y., a corporation of New York

Application December 19, 1936, Serial No. 116,709

8 Claims. (Cl. 154—44)

This invention relates to a sound absorbing article. More particularly, this invention relates to a sound-absorbing article which can be employed as an acoustical treatment for a room, auditorium, or the like.

A number of sound-absorbing articles heretofore used have included perforated or porous facing elements permitting incident sound to pass therethrough to a rearwardly disposed sound-absorbing member. Cleaning the face of such articles by washing may involve wetting the sound absorbing material, and breathing of air through the perforations may cause uneven deposition of dirt, unless a special antibreathing sound absorbent is used.

The majority of sound-absorbing articles show a preferential absorption or peak of effectiveness when the sound to be absorbed is of a given frequency, with a decrease in efficiency, when the frequency of the sound to be absorbed is lower or higher than the optimum for the material used. The result is frequently distortional of the original quality of the sound.

It is an object of the present invention to provide a sound absorbing article having a facing element that may be readily washed or otherwise cleaned without injury to the sound absorbing material therebehind. Another object is to provide a sound absorbing article having a facing element that does not permit breathing or passage otherwise of air in substantial amount therethrough. A further object is to provide a construction which is less selective in sound absorption than an element showing a sharp peak of absorption at a given frequency.

In general, the invention comprises the novel features of the sound-absorbing article herein described, the term "article" including construction or assembly. More particularly, the invention comprises an acoustical article in which a readily vibratile, air-impermeable sheet is disposed in contact, over the major portion of its area, preferably, substantially continuously, with a vibration-damping material, the said sheet being not adhered over the said major portion of the damping material. One embodiment comprises two air-impermeable readily vibratile sheets and a layer of vibration-damping and, suitably, sound-absorbing material disposed therebehind or therebetween, the sheets again being non-adhered and not otherwise secured as before. The invention comprises, also, a sound-absorbing article including a member, as, for example, a felt, adapted to absorb preferentially sound of a given frequency, a vibratile facing sheet disposed in front of the said member, contacting therewith at close intervals, but not adhered thereto over the major portion of its area, and means confining air behind the said sheet, the said sheet in the article described having a natural vibration frequency different from the frequency of the sound preferentially absorbed by the said member.

The invention is illustrated in the attached drawing and will be described for the purpose of exemplification in connection therewith.

Fig. 1 is a cross sectional view of my improved article.

Fig. 2 is a cross sectional view of a modification of the invention.

There is shown a vibration-damping member 11 that is suitably light in weight, readily yieldable, and adapted to absorb sound. This member may include a porous felt of hair, mineral wool, or like material.

Disposed over the said member is a thin readily vibratile sheet facing element (membrane) 12 for which I have used to advantage a metal foil, such as three-ounce copper, paper, or other substantially air-impermeable sheet material, as, for instance, lightweight tar paper or asphalt-impregnated roofing felt. By "air-impermeable" is meant not substantially permeable to air-borne sound.

If desired, there may be a plurality of the sheet facing elements. Thus, another sheet 13 may be disposed between the member 11 and the element 12. This element 13, as well as the elements 14 and 15 (see Fig. 2), may be of the kind described in connection with the element 12. Particularly desirable results have been obtained when there is used a thick hair felt 11, say, one made by the so-called punching process, a partially saturated rag felt constituting the element 13 and made, for instance, as described in U. S. Patent 2,008,654 issued to Clarvoe on July 16, 1935, and copper foil as the outer facing 12 exposed directly to the incident sound.

In the modification shown in Fig. 2, the sound-absorbing felt 11 is disposed between the facing element 14 and a backing element 15.

In these embodiments of the invention, the sheet elements 12, 13, 14, and 15 are vibratile and capable of movement relatively to said member over the entire area of said member and not adhered or otherwise secured thereto. These elements suitably lie normally directly upon or against the face of the member 11 or upon each other. When there is used a plurality of facing elements on one side of the damping material,

as illustrated in Fig. 1, the rearwardly disposed of the said elements, that is, the element 13, may be in contact on its face with the element 12 and on its back with the damping member 11.

In a typical construction, the acoustical article or assembly described may be associated with supporting frame members, such as the wooden or metal furring strips 16, defining therebetween a space to receive the sound-absorbing material. The outer or both of the sheet elements 12 and 13 or 14 and 15 may extend at their edge portions over the frame members and be secured thereto, as by the fasteners 17.

A substantially air-impermeable base or wall 19 coacting with the strips 16 constitute suitable means for confining air behind the vibratile sheet disposed over, that is, in front of or against the felt. This wall defines a space 20 with the sheet backing element 15, Fig. 2, that is, with that side of one of the readily vibratile sheets that is away from the member 11, as illustrated.

The elements 12, 13, 14, and 15 are of high damping coefficient, as distinguished, for example, from taut drum-like membranes that, once set in vibration, tend to continue vibrating after the impulse originating the vibration is ended. The elements are readily vibratile, by which term is meant adapted to be set in vibration by incident sound of usual intensity. Suitably, they are of natural vibration frequency, that is, in the finished assembly, of the order of the predominant frequency of the sound to be absorbed.

When sound is incident upon one of these elements and vibration is set up therein, the element, because of its high damping coefficient, tends to lose its vibration. A part of the energy used in initiating the vibration is, therefore, lost. A portion of the sound is reflected from the element and another porition is transmitted by vibration of the element. This latter portion of the sound has access to the member 11 which, if a porous felt of the kind described, absorbs the sound in large measure.

In addition, the member 11 or other element if disposed in contact with the back of the vibrating element, serves to damp the vibration of that element. When there is used the combination including a plurality of sheet elements, as shown in Fig. 1, the intermediate element 13 may damp the other element 12 while being itself, in turn, damped by the member 11.

The elements 12 and 13, whether vibrating jointly or singly, have a natural vibration frequency that is different from the frequency of the sound absorbed preferentially, that is, at maximum efficiency, by the member 11.

When the elements 12 and 13 are secured together, there is used a suitable adhesive (not shown), as, for example, a bituminous, rubber, or resinous cement.

If one of these is particularly light in weight and of low damping efficiency, then the other of the elements should be of relatively greater mass and damping efficiency.

A construction of this kind is to be distinguished from a somewhat similar article in which a facing element is adhered practically continuously to the face of a damping material such as the felt 11. In this latter case, in which the facing element is not free to vibrate independently of the felt, there has been observed loss in effectiveness of absorption of sound of certain frequencies.

This distinction is illustrated by the following comparative data for sound-absorbing articles including each a three-fourths inch felt as the member 11, 12-pound asphalt-impregnated roofing paper as element 13, and two-ounce copper sheeting as the element 12. In the articles, the facing element 12 was adhered to the intermediate element 13 which, in one case, was adhered to the member 11, the adherence being substantially continuous. In the other case, the element 13, was capable of free movement relatively to the member 11 over the entire area thereof. The elements 12 and 13 jointly constitute the vibratile member referred to in the following table showing the sound-absorption results.

Predominating frequency of the incident sound, cycles per second	Absorption of sound, percent	
	Vibratile member not adhered to member 11	Vibratile member adhered substantially continuously to member 11
256	35	43
375	65	26
512	43	20

The great increase of absorption at 375 and 512 cycles, without a corresponding decrease at 256 cycles, due to the non-adherence of the facing elements, will be noted.

In the article shown in Fig. 2, the element 14 disposed in front of the damping member 11 is of lighter weight and/or higher natural vibration frequency than the element 15 disposed behind the damping material 11.

Sound incident upon the facing 14, to impinge upon the element 15 of necessity, will pass first through the damping member 11. When this latter member is sound-absorbing, in accordance with the preferred practice of the invention, sounds that are particularly difficult to absorb in ordinary constructions such as the felt alone, namely, the sounds of very low frequency will predominate in the sound impinging upon element 15.

The embodiment shown in Fig. 2 may use between the vibratile elements a relatively thin felt, as, for instance, one of about one-fourth to one-half inch thickness or less.

It will be understood that the details given are for the purpose of illustration, not restriction, and that variations within the spirit of the invention are intended to be included in the scope of the appended claims.

What I claim is:

1. A sound-absorbing article comprising two readily vibratile air-impermeable sheets and a sound-absorbing and vibration-damping member disposed therebetween, the said sheets being arranged to vibrate relatively to said member and when vibrating to be in free contact with the said member over major and continuous portions of their areas.

2. A sound-absorbing article as described in claim 1, including means confining air on the side of one of the said sheets away from the said member.

3. A sound-absorbing article as described in claim 1, the said vibratile sheets being of different natural vibration frequencies and the one of the sheets of higher natural vibration frequency being exposed on its outer face to the sound to be absorbed, so that the sound incident upon the other sheet, of lower frequency of vibration, will have passed through the said member before impinging upon the said other sheet.

4. A sound-absorbing article comprising a base, a substantially air-impermeable vibratile sheet

disposed over and in spaced relationship to said base and exposed on its face to the sound to be absorbed, a compressible, fibrous vibration-damping member confined behind said sheet and capable of independent movement relatively to said sheet over the entire area of said member, said member being in contact with the major portion of the area of the sheet when the latter is vibrating, whereby said member serves to damp vibrations of said sheet, and independent means defining a predetermined area supporting said sheet from said base.

5. A sound-absorbing article comprising a base, a thin, substantially air-impermeable, metal facing element disposed over and in spaced relationship to said base, said element being freely vibratile under the influence of incident sound, a compressible, fibrous vibration-damping member confined behind said element and capable of independent movement relatively to said element over the entire area of said member, said member being in contact with the major portion of the area of the element when the latter is vibrating, whereby said member serves to damp vibrations of said element, and independent means defining a predetermined area supporting said element from said base.

6. A sound-absorbing article comprising a base, a vibratile diaphragm comprising substantially air-impermeable superposed sheets disposed over and in spaced relationship to said base, a compressible, fibrous sound-absorbing member confined behind said superposed sheets and capable of independent movement relatively to said sheets over the entire area of said member, said member being in contact with the major portion of the area of the adjacent of said sheets when said diaphragm is vibrating, whereby said member serves to damp vibrations of said sheet, and independent means defining a predetermined area supporting said diaphragm from said base.

7. A sound-absorbing article comprising a base, a substantially air-impermeable vibratile sheet disposed over and in spaced relationship to said base and exposed on its face to the sound to be absorbed, a compressible, fibrous vibration-damping member behind said sheet and capable of independent movement relatively to said sheet over the entire area of said member, said member being sound-absorbing and said sheet, as assembled in the article, having a natural vibration frequency different from the frequency of the sound absorbed most effectively by said member, said member being in contact with the major portion of the area of the sheet when the latter is vibrating, whereby said member serves to damp said vibrations of said sheet, independent means defining a predetermined area supporting said sheet from said base, and means confining air behind said member.

8. A sound-absorbing article comprising a base, a substantially air-impermeable vibratile sheet disposed over and in spaced relationship to said base and exposed on its face to the sound to be absorbed, said sheet having a natural vibration frequency of the order of the predominate frequency of the sound to be absorbed, and a compressible, fibrous, sound-absorbing, vibration-damping member confined behind said sheet and capable of independent movement relatively to said sheet over the entire area of said member, said member being in contact with the major portion of the area of the sheet when the latter is vibrating, whereby said member serves to damp vibrations of said sheet, independent means defining a predetermined area supporting said sheet from said base, and means for confining air behind said member.

JOHN S. PARKINSON.