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[54] **SOUND ABSORBER CONSTRUCTION**

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[21] Appl. No.: **880,550**

[30] **Foreign Application Priority Data**

Nov. 30, 1968 Germany ....P 18 11 998.7

[52] **U.S. Cl.** ....**181/33 G**
[51] **Int. Cl.**...**E04b 1/86**
[58] **Field of Search** 181/33, 33.1, 33.11, 33.04, 181/42, 50, 71

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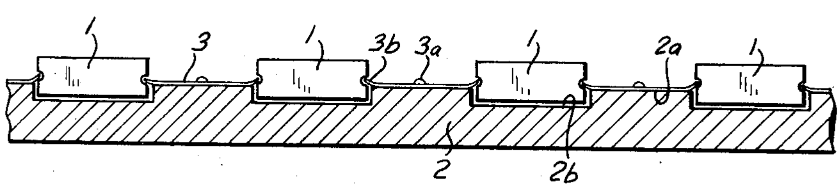
[57] **ABSTRACT**

A sound absorber construction for absorbing sound waves transmitted through a liquid medium. A support having an exposed surface area is provided with a plurality of discrete sound absorbing units distributed over the surface area with spacing from one another. Mounting means connects the sound-absorbing units to one another and also mounts them on the exposed surface area of the support.

16 Claims, 8 Drawing Figures



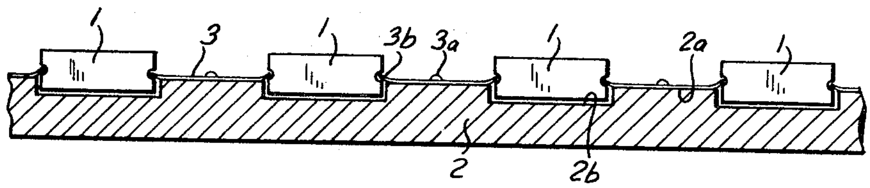


FIG. 1

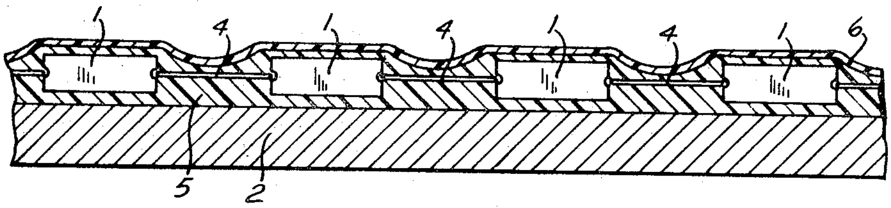


FIG. 2

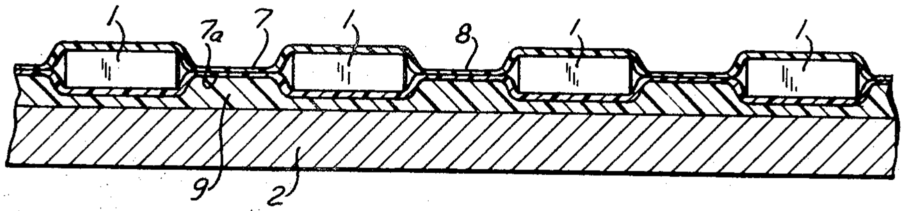


FIG. 4

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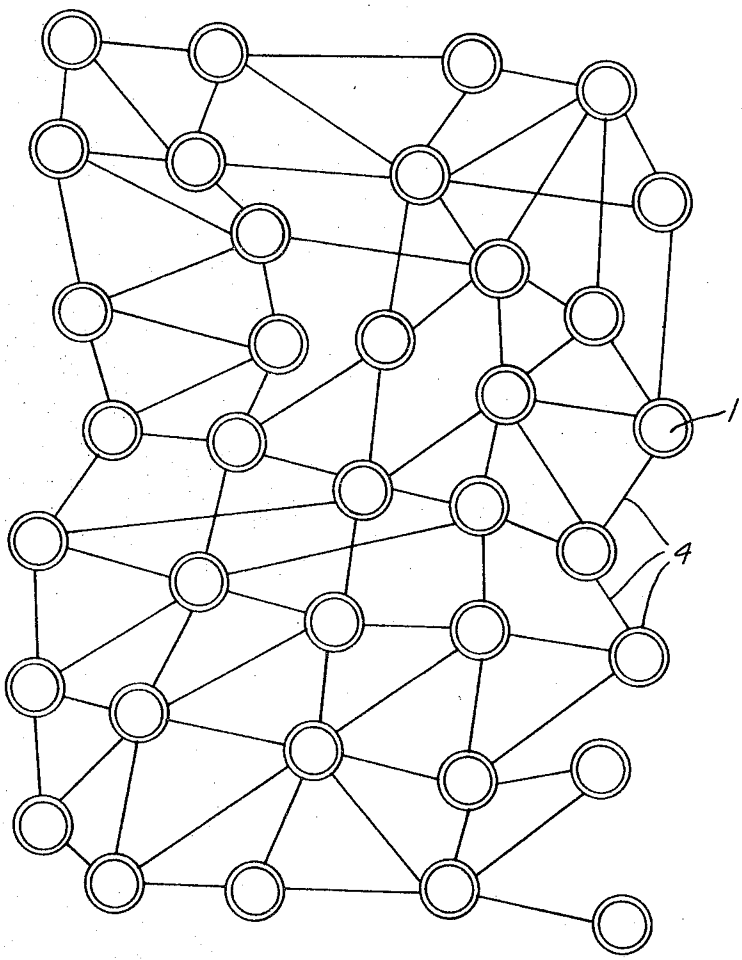

FIG. 3

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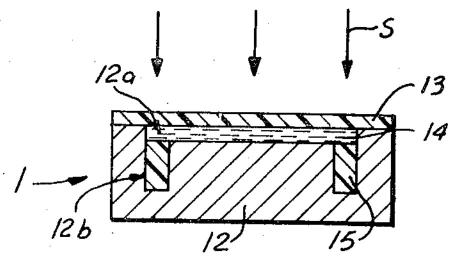

FIG. 5

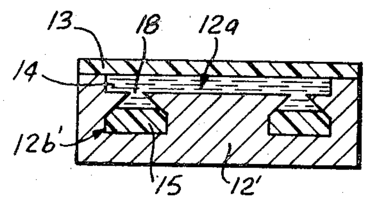

FIG. 6

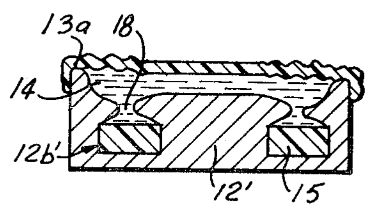

FIG. 7

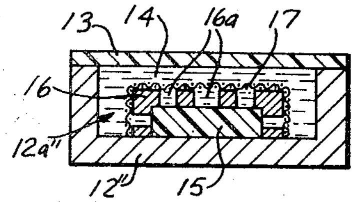

FIG. 8

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SOUND ABSORBER CONSTRUCTION

BACKGROUND OF THE INVENTION

The present invention relates generally to a sound absorber construction, and more particularly to a sound absorber construction for absorbing sound waves transmitted through a liquid medium. Still more specifically the invention relates to a composite sound absorber construction of the type under discussion.

Sound absorbers per se, including those specifically adapted for absorbing sound waves transmitted through a liquid medium, are already known. However, particularly absorption layers for absorbing sound waves transmitted through a liquid medium have a certain lack of flexibility which makes it difficult to affix them to doubly curved surfaces. This is a decided disadvantage which greatly limits the range of applicability of sound-absorbing units for this purpose.

A further problem is that the individual sound-absorbing elements cannot be readily deformed in accordance with the requirements of a surface to which they are to be affixed. Thus, if the sound-absorbing element itself is based on the principle utilizing liquid inclusions in an elastomeric material, then the application of the sound-absorbing element to a doubly curved surface may result in deformations of the liquid inclusions which disadvantageously influence the absorption characteristics. It is well known that in this particular type of sound-absorbing element it is essential that the liquid inclusion be capable of moving from one location to another in response to the impingement of sound waves and consequent oscillation of the element, and subsequently to return to their original location. This takes place through channel-shaped or tubular conduits or similar spaces of very small cross-sectional dimensions, and any deformation of the sound-absorbing element resulting from application thereof to a curved surface may cause the formation of constrictions, deformations or the like in the channels or similar passages through which the liquid is to flow, thereby preventing proper flow of the liquid and disadvantageously influencing the absorption characteristics.

A further problem encountered is the fact that it is not easy to affix these relatively stiff elements to doubly curved surfaces, because the absorption layers utilized are of specific types of synthetic plastic materials which cannot be readily affixed by any and all means, so that the particular means most suitable for such affixing from a point of establishing a connection is not necessarily usable. For this reason, such absorption layers have heretofore primarily been used for affixing to planar or substantially planar surfaces.

SUMMARY OF THE INVENTION

It is a general object of the present invention to overcome the aforementioned disadvantages of the prior art.

More particularly it is an object of the present invention to provide an improved sound absorber construction for absorbing sound waves transmitted through a liquid medium.

Still more specifically it is an object of the present invention to provide such an improved sound absorber construction which is not possessed of the aforementioned disadvantages.

A concomitant object of the invention is to provide such a sound absorber construction which can be readily and quickly affixed to doubly or otherwise curved surfaces.

In pursuance of the above objects, and others which will become apparent hereafter, the present invention provides a sound absorber construction for absorbing sound waves transmitted through a liquid medium which construction comprises, briefly stated, a support having an exposed surface area, a plurality of discrete sound-absorbing units distributed over said exposed surface area with spacing from one another, and mounting means for connecting the sound-absorbing units to one another and for mounting them on the exposed surface area of the support.

It is thus an important concept according to the present invention that the sound-absorbing elements are in form of discrete sound-absorbing units which are suitably connected with one another and in turn thus connected to the support. The mounting means utilized for connecting the sound-absorbing units to one another and to the support may be of various different types. It may also utilize different types of materials and, because it may be very thin and flexible, it permits ready and simple affixing and accommodation of the entire sound absorber construction to most any desired surface, including and particularly doubly curved surfaces.

The mounting means may include two superimposed foils, for instance of synthetic plastic material, between which the individual sound-absorbing units are located with spacing from one another, with the foils being connected—for instance by heat welding if they are of material permitting such processing—to thereby maintain the sound-absorbing units in place. The composite of foils and sound-absorbing units is then affixed to a desired support surface. This may be accomplished in various different ways, for instance by means of adhesives or another suitable binder.

Furthermore, the mounting means may be in form of a single or composite layer of embedding material which is affixed as by adhering to the exposed surface area of a support, and in which the sound-absorbing units are embedded. Such material may be soft and pliable at the time the units are embedded and may become tenacious, rigid or elastomeric as it sets.

A further possibility is to utilize a net or mesh fabric with the discrete sound-absorbing units being disposed and retained in respective apertures of the mesh. Such a net or mesh may consist of synthetic or glass fibers, and the characteristics of these fibers may be so selected as to be compatible with the material by means of which the net or mesh with the secured sound-absorbing units is affixed to the surface area of the support. Among the synthetic plastic fibers usable for the construction of such nets or mesh fabrics are synthetic high polymers. These may be used by themselves or in conjunction with glass fibers, and the latter may of course be used alone also. The use of glass fibers especially permits an improvement of the mechanical characteristics of the binder material which affixes the mesh or net with the sound-absorbing units to the support. The binder material may itself be a plastic on natural basis, or a synthetic plastic. It may also be a natural or synthetic elastomer.

It is also possible to provide the exposed surface area of the support itself with recesses, or with projections which define between themselves recesses, in which the respective discrete sound-absorbing units are located and retained in suitable manner. The configuration of the sound-absorbing units themselves is advantageously substantially button shaped because in this manner they can be very simply and readily embedded, inserted into openings of a mesh- or net-type fabric or introduced in recesses in or on the exposed surface area of the support which because of their simple configuration can be most readily produced. Additionally, a button-shaped configuration is particularly suitable for mass production. Of course, the sound-absorbing units themselves may be of button-shaped configuration or they may be encapsulated in button-shaped casings. It is a particularly advantageous characteristic of making the sound-absorbing units rather small and of button-shaped configuration that they are not subject to deformation when they are affixed to the support and so that therefore their absorption characteristics are therefore not changed.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a fragmentary diagrammatic section through a support to which a plurality of discrete sound-absorbing units are directly affixed;

FIG. 2 is a view similar to FIG. 1 but illustrating the affixing of sound-absorbing units to a support by means of a net-type mounting means in conjunction with a binder material;

FIG. 3 is a diagrammatic fragmentary plan view of the embodiment shown in FIG 2, illustrating the distribution of the sound-absorbing units;

FIG. 4 is a sectional view similar to FIG. 3 but illustrating the mounting of sound-absorbing units by means of superimposed foils;

FIG. 5 is a diagrammatic section through one embodiment of a sound-absorbing unit according to the present invention;

FIG. 6 is a view similar to FIG. 5 but illustrating a further embodiment of a sound-absorbing unit according to the present invention;

FIG. 7 is a view similar to FIG. 6 but illustrating a modified embodiment; and

FIG. 8 is a view similar to FIG. 5 illustrating a further embodiment of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Discussing now the drawing in detail, and firstly the embodiment illustrated in FIG. 1, it will be seen that reference numeral **1** identifies a plurality of discrete sound-absorbing units which in FIG. 1 are shown only in diagrammatic outline. These sound-absorbing units **1** may be of various different constructions, for instance of the embodiments illustrated specifically in FIGS. **5–8** which will be discussed subsequently.

Reference numeral **2** identifies a portion of a support, such as the wall of a liquid-containing vessel. The exposed surface area **2***a* of the support **2***b* may of course be planar or near-planar, it may be irregular or it may be curved in any manner. In the illustrated embodiment the exposed surface area **2***a* is provided with a plurality of spaced recesses **2***b* so configurated as to each accommodate therein one of the sound-absorbing units **1**. The latter are provided with cutouts, depressions, recesses, or other abutment portions **3***b*, and springs **3** which are suitably affixed at **3***a* to the support **2** engage in the cutouts **3***b* and serve to retain the sound-absorbing units in their respective recesses **2***b*. Thus, the combination of the sound-absorbing units **1**, the support **2**, the springs **3**—which may be leaf springs or which may be replaced by analogous means capable of performing the same function—and the cutouts **3***b* together constitutes a sound absorber construction according to the embodiment of FIG. 1.

In the embodiment of FIG. 2 like reference numerals identify the like elements as in FIG. 1. Here, however, the discrete sound-absorbing units **1** are each received and retained in an opening of a mesh-type or net-type retaining member **4**, as also shown in FIG. 3 from which the distribution of the units **1** may be ascertained. As mentioned before, the retaining member **4** may consist of synthetic fibers, of glass fibers, of a combination of such fibers or of other suitable material. The member **4** together with the retained sound-absorbing units **1** is embedded in a layer **5** of synthetic or elastomeric material which adheres to the support **2**. The exposed side of this layer **5** has placed over it and secured thereto a cover foil or cover layer **6**, which may also be of synthetic plastic material.

It is emphasized that in FIG. 3 the foil **6** has been omitted for the sake of clarity of illustration.

In the embodiment of FIG. 4 the discrete sound-absorbing units **1** are located between two foils **7**, **7***a* which may for instance consist of synthetic plastic material as illustrated. These foils **7**, **7***a* are connected intermediate the spaced sound-absorbing units **1**—for instance by heat welding if the character of their material permits this, by bonding or in other suitable manner—in order to retain the sound-absorbing units **1** at their intended locations. A layer **9** of suitable adhesive material, for instance on a synthetic plastic basis, connects the thus-obtained construction to the exposed surface area of the support **2**.

It is emphasized that the spacing of the discrete sound-absorbing units **1** from one another does not disadvantageously influence the absorption characteristics obtained with the sound absorber construction according to the present invention, because the active cross section of the sound-absorbing units is greater than the cross section of the individual units. For this reason it is also possible to introduce between the sound-absorbing units **1**, which may be single- or multiple-stage resonant elements, other absorbent or scattering elements and to thereby significantly increase the range of applicability of the sound absorber construction according to the present invention. Specifically, this makes it possible to arrange absorption elements adjacent one another whose maximum absorption is selected with respect to different static pressure ranges, or which absorb according to different principles, without encountering in the production of such a sound absorber excessive technical difficulties as was heretofore the case. This permits the construction of sound absorbers having a high frequency width of absorption and a great range of permissible static pressures. Moreover, such constructions can be provided on surfaces of whatever curvature. It is advantageous to arrange the individual sound-absorbing units **1** in accordance with statistical distribution, that is in accordance with a predetermined pattern which has been determined by statistical means. This prevents the formation of an imbalanced construction.

It should be noted that it is important for achieving a satisfactory construction in accordance with the present invention that the mounting means, including the material securing or embedding the sound-absorbing units to the support **2**, be completely free of unintended air inclusions, such as air bubbles, voids or the like.

The embodiments illustrated in FIGS. **5–8** show different sound-absorbing units suitable for use in the inventive sound absorber construction. Generally speaking, the sound-absorbing units **1** of FIGS. **1–4** are most advantageously low-reflection water sound absorbers of one or several single-stage or multiple-stage resonance elements in form of neighboring membranes of elastomeric materials in front of or on a backing or base, with the elastomeric membranes being connected with a portion of the absorber which does not share the oscillatory movements of the membranes via a liquid, particularly a silicon oil because of the temperature independence thereof, which liquid provides for broadband and temperature-independent accommodation of the acoustical resistance of the absorber to the wave resistance of water, and wherein one or several spaces filled with a compressible medium communicate with the space filled with the liquid intermediate the membrane and that part of the absorber which does not share the oscillatory movement of the membrane.

Constructions based on the above principle are already known and have been found to largely eliminate temperature dependence of sound absorption. However, by making the sound-absorbing units of generally button-shaped configuration in accordance with the present invention, it is further possible to eliminate static pressure effects within wide ranges. This is achieved, in accordance with the present invention, by so constructing the sound-absorbing units that they contain at least two internal spaces which communicate with one another through a flow-restricting gap and one of which contains the compressible medium whereas the other contains the liquid and is closed by the elastomeric membrane.

FIG. **5** shows one possible embodiment of a sound-absorbing unit **1** according to the present invention. The arrows S in FIG. **5** indicate the direction of sound wave impingement upon the unit **1**, and while they are not shown in FIGS. **6–8** it is to be understood that the direction of sound impingement is analogous as in FIG. **5**, that is in each case the sound waves impinge in a direction from the top towards the bottom of the drawing.

The unit **1** shown in FIG. **5** comprises a base **12** which in the illustrated embodiment is of metallic material, but which could be of a synthetic plastic material or of a combination of synthetic plastic material with metallic material. An exposed face of the base **12** is provided with a circular depression **12***a*, and the bottom wall of the same is further provided with an annular depression or recess **12***b*. The open side of the depression **12***a* is closed by a layer, membrane or diaphragm **13** of flexible—e.g., elastomeric—material. The depression **12***a* accommodates a liquid **14** such as a silicon oil, which is capable of broadband temperature-independent accommodation of the acoustical resistance of the unit **1** to the wave resistance of water. The depression **12***b* accommodates a compressible medium **15**. Oscillations of the membrane **13** in response to impingement of the sound waves S force the liquid **14** from the depression **12***a* into the depression **12***b* with compression of the compressible medium **15** therein, and subsequently the liquid then returns to the depression **12***a* in accordance with the principle already well known to those skilled in the art.

The embodiment illustrated in FIG. **6** differs from that FIG. **5** of certain respects. Like reference numerals identify like elements. Here, however, the base **12'** is provided with an annular recess **12***b'* which communicates with the recess **12***a* via a narrow flow-restricting annular gap **18**. The recess **12***b'* accommodates the compressible medium **15** as before, and the recess **12***a* accommodates the liquid **14**. The presence of this flow-restricting gap **18** assures that the embodiment in FIG. **6** is largely independent with respect to its absorption characteristics of the exterior static pressure.

The embodiment illustrated in FIG. **7** is analogous to that of FIG. **6**. It differs from the latter primarily in that it is simpler to manufacture. Whereas in FIG. **6** the base member **12'** requires machining in order to produce the recesses or depressions **12***a*, **12***b'* and the flow-restricting gap **18** between them, these recesses and gap can be produced in a more simple manner in accordance with the embodiment of FIG. **7**. Like reference numerals again identify like elements, but it is pointed out that in FIG. **7** less dimensional accuracy is required in making the recesses so that the same may be produced for instance by stamping. The membrance **13***a* may also be applied in somewhat different manner in that its edges overlap the outer sides of the base member **12'**.

Finally, the embodiment illustrated in FIG. **8** is a construction which is not only independent of temperature but also independent of exterior static pressure. Again, like reference numerals identify like elements. Here, however, the base member **12''** is of substantially cup-shaped configuration with its interior constituting a circular or substantially circular depression **12***a''* corresponding for instance to the depression **12***a* of FIG. **5**. The open side of the depression **12***a''* is closed by the membrane or diaphragm **13**. Accommodated in the interior of the depression **12***a''* is an apertured member **16** provided with the apertures **16***a* and also being of substantially cup-shaped configuration, but with its open side facing the bottom of the base member **12''**. The interior of this apertured cup-shaped member **16** constitutes the equivalent of the recess **12***b* of FIG. **5** and accommodates the compressible medium **15**. Placed about the exterior of the apertured cup-shaped member **16** is a fine-mesh net or similar material **17** whose small mesh apertures, through which the liquid **14** must pass when it is displaced from the recess **12***a''* into the interior of the apertured member **16** in response to impingement of sound waves upon the membrane or diaphragm **13**, constitute the equivalent of the flow-restricting gap **18** of FIGS. **6** and **7**.

Of course, it is also possible to construct the base members **12**, **12'**, etc., of two parts, with each part accommodating one of the recesses **12***a*, **12***b*, particularly in embodiments where the flow-restricting gap **18** is present, because each of the two parts can then be provided with one of these recesses and they can open at the interface at which the two parts engage one another, with the gap being provided at this interface. This enables a more simple and less expensive manufacture of the base member.

With respect of the flow-restricting gap **18**, or the equivalent mesh apertures of the mesh member **17** of FIG. **8**, it is pointed out that it is advantageous for the width or diameter of the gap not to exceed 100 microns. This means, of course, that it may be smaller than this value.

It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of applications differing from the types described above.

While the invention has been illustrated and described as embodied in a sound absorber construction, it is not intended to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can be applying current knowledge readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention.

What is claimed as new and desired to be protected by Letters Patent is set forth in the appended claims:

1. A sound absorber construction for absorbing sound waves transmitted through a liquid medium, comprising a support having an exposed surface area; a plurality of discrete sound-absorbing units distributed over said exposed surface area with spacing from one another; and mounting means for mounting said units on said support, comprising recesses provided in said exposed surface area of said support and each accommodating one of said units, and spring retaining members engaging the respective units and retaining them in said recesses.

2. A sound absorber construction as defined in claim **1**, said units being provided with respective depressions, and said retaining springs being elongated and each having a first end portion just with said support and a second end portion received in one of said depressions.

3. A sound absorber construction for absorbing sound waves transmitted through a liquid medium, comprising a support having an exposed surface area; a plurality of discrete sound absorbing units distributed over said exposed surface area with spacing from one another; and mounting means for mounting said units on said support, comprising a mounting member of mesh material having a plurality of mesh apertures in which the respective units are accommodated and retained, and connecting means connecting said mounting member to said surface area overlying the same.

4. A sound absorber construction for absorbing sound waves transmitted through a liquid medium, comprising a support having an exposed surface area; a plurality of discrete sound absorbing units distributed over said surface area and each comprising a nonoscillatory base member having a pair of recesses and at least one throttling gap connecting said recesses, one of said recesses having an open side and a layer of elastic material overlying said open side closing said one recess, liquid means accommodated in said one recess, and a compressible medium in the other of said recesses; and mounting means connecting said units and mounting the same on said surface area.

5. A sound absorber construction as defined in claim **4**, wherein said units are substantially button shaped.

6. A sound absorber construction as defined in claim **4**, said mounting means comprising a pair of superimposed foil members at predetermined locations of the same and said foil members being connected together intermediate said predetermined locations, and connecting means connecting said foil members to said surface area overlying the same.

7. A sound absorber construction as defined in claim **4**, said mounting means comprising engaging means engaging said units and connecting them with one another, and adhesive means adhesively mounting said engaging means on said surface area.

8. A sound absorber construction as defined in claim **4**, said mounting means comprising engaging means engaging said units and connecting them with one another, and a layer of hardenable bonding material mounting said engaging means on said surface area.

annular depression or recess **12***b*. The open side of the depression **12***a* is closed by a layer, membrane or diaphragm **13** of flexible—e.g., elastomeric—material. The depression **12***a* accommodates a liquid **14** such as a silicon oil, which is capable of broadband temperature-independent accommodation of the acoustical resistance of the unit **1** to the wave resistance of water. The depression **12***b* accommodates a compressible medium **15**. Oscillations of the membrane **13** in response to impingement of the sound waves S force the liquid **14** from the depression **12***a* into the depression **12***b* with compression of the compressible medium **15** therein, and subsequently the liquid then returns to the depression **12***a* in accordance with the principle already well known to those skilled in the art.

The embodiment illustrated in FIG. **6** differs from that FIG. **5** of certain respects. Like reference numerals identify like elements. Here, however, the base **12'** is provided with an annular recess **12***b'* which communicates with the recess **12***a* via a narrow flow-restricting annular gap **18**. The recess **12***b'* accommodates the compressible medium **15** as before, and the recess **12***a* accommodates the liquid **14**. The presence of this flow-restricting gap **18** assures that the embodiment in FIG. **6** is largely independent with respect to its absorption characteristics of the exterior static pressure.

The embodiment illustrated in FIG. **7** is analogous to that of FIG. **6**. It differs from the latter primarily in that it is simpler to manufacture. Whereas in FIG. **6** the base member **12'** requires machining in order to produce the recesses or depressions **12***a*, **12***b'* and the flow-restricting gap **18** between them, these recesses and gap can be produced in a more simple manner in accordance with the embodiment of FIG. **7**. Like reference numerals again identify like elements, but it is pointed out that in FIG. **7** less dimensional accuracy is required in making the recesses so that the same may be produced for instance by stamping. The membrance **13***a* may also be applied in somewhat different manner in that its edges overlap the outer sides of the base member **12'**.

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Of course, it is also possible to construct the base members **12**, **12'**, etc., of two parts, with each part accommodating one of the recesses **12***a*, **12***b*, particularly in embodiments where the flow-restricting gap **18** is present, because each of the two parts can then be provided with one of these recesses and they can open at the interface at which the two parts engage one another, with the gap being provided at this interface. This enables a more simple and less expensive manufacture of the base member.

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2. A sound absorber construction as defined in claim **1**, said units being provided with respective depressions, and said retaining springs being elongated and each having a first end portion just with said support and a second end portion received in one of said depressions.

3. A sound absorber construction for absorbing sound waves transmitted through a liquid medium, comprising a support having an exposed surface area; a plurality of discrete sound absorbing units distributed over said exposed surface area with spacing from one another; and mounting means for mounting said units on said support, comprising a mounting member of mesh material having a plurality of mesh apertures in which the respective units are accommodated and retained, and connecting means connecting said mounting member to said surface area overlying the same.

4. A sound absorber construction for absorbing sound waves transmitted through a liquid medium, comprising a support having an exposed surface area; a plurality of discrete sound absorbing units distributed over said surface area and each comprising a nonoscillatory base member having a pair of recesses and at least one throttling gap connecting said recesses, one of said recesses having an open side and a layer of elastic material overlying said open side closing said one recess, liquid means accommodated in said one recess, and a compressible medium in the other of said recesses; and mounting means connecting said units and mounting the same on said surface area.

5. A sound absorber construction as defined in claim **4**, wherein said units are substantially button shaped.

6. A sound absorber construction as defined in claim **4**, said mounting means comprising a pair of superimposed foil members at predetermined locations of the same and said foil members being connected together intermediate said predetermined locations, and connecting means connecting said foil members to said surface area overlying the same.

7. A sound absorber construction as defined in claim **4**, said mounting means comprising engaging means engaging said units and connecting them with one another, and adhesive means adhesively mounting said engaging means on said surface area.

8. A sound absorber construction as defined in claim **4**, said mounting means comprising engaging means engaging said units and connecting them with one another, and a layer of hardenable bonding material mounting said engaging means on said surface area.

9. A sound absorber construction as defined in claim 4, said mounting means comprising engaging means engaging said units and connecting the same with one another, and a layer of settable normally at least slightly resilient bonding material embedding said engaging means in deformable state and mounting the thus embedded engaging means on said surface area.

10. A sound absorber construction as defined in claim 4, and further comprising a cover layer of sound permeable material on said units and said mounting means.

11. A sound absorber construction as defined in claim 4, said units being distributed in accordance with a preselected statistically determined pattern.

12. A sound absorber construction as defined in claim 4, said liquid means being operative for temperature-independent broadband accommodation of the acoustical resistance of the respective unit to the wave resistance of said liquid medium.

13. A sound absorber construction as defined in claim 12, said base member being composed of two abutting sections each of which is provided with one of said recesses, and wherein said throttling gap is provided at and connects said recesses in the region of the interface between said abutting sections.

14. A sound absorber construction as defined in claim 12, said base member consisting at least substantially of metallic material.

15. A sound absorber construction as defined in claim 12, wherein said throttling gap has a width of most substantially 100μ.

16. A sound absorber construction as defined in claim 12, said base member having an exposed face provided with a depression having on open side, and said layer of elastic material overlying said depression; and further comprising a perforate substantially cup-shaped member received in said depression and having a closed side facing said open side so as to subdivide said depression into said first recess located exteriorly of said second recess located interiorly of said cup-shaped member, and a fine-mesh screen overlying and supported by said cup-shaped member and having mesh openings which together constitute said throttling gap.

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