April 19, 1955 R. R. ABRAMS 2,706,530

FUNCTIONAL SOUND ABSORBER AND METHOD OF ABSORBING SOUND

Filed April 29, 1953

Fig. 1

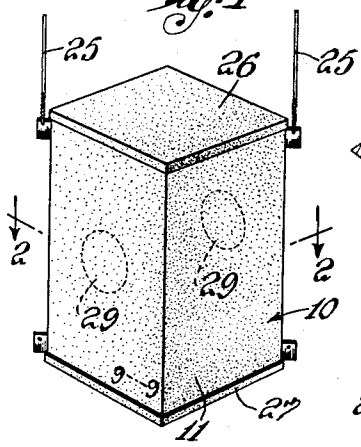


Fig. 2

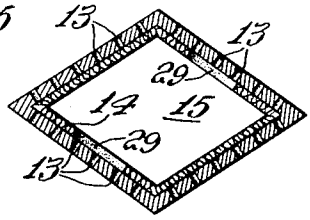


Fig. 3

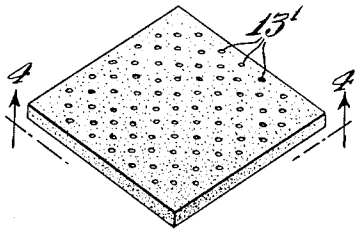


Fig. 4

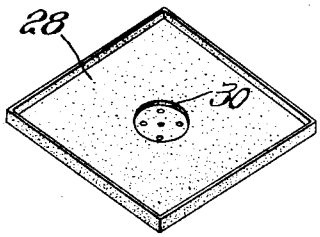


Fig. 5

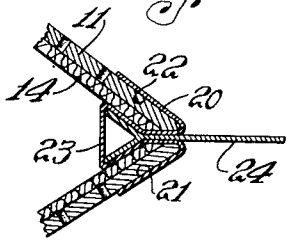


Fig. 6

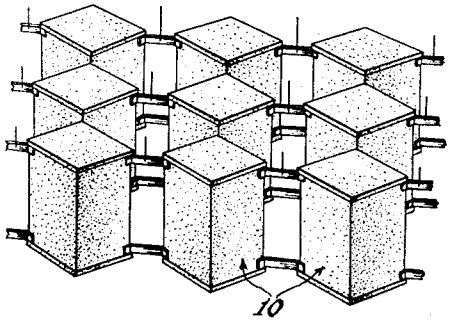


Fig. 7

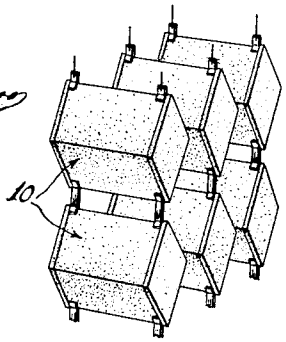


Fig. 8

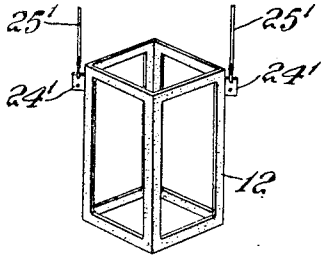


Fig. 9

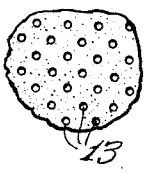
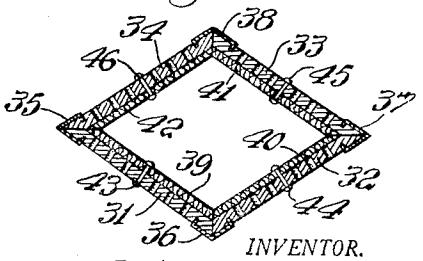


Fig. 10



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United States Patent Office 2,706,530 Patented Apr. 19, 1955

2,706,530

FUNCTIONAL SOUND ABSORBER AND METHOD OF ABSORBING SOUND

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Application April 29, 1953, Serial No. 351,815

8 Claims. (Cl. 181—33)

This invention relates to a functional sound absorber especially adapted for use in industrial commercial and other installations wherein concentrated conditions of noise are encountered, covering a broad band of frequencies extending over the entire audible range. The invention is adapted for use in many areas and conditions and particularly where it is impractical to apply conventional acoustical treatment methods.

The invention comprises a self-contained functional sound absorber unit which may be freely suspended so as to completely expose all surfaces thereof to the sound waves radiated by the noise source. As will appear from a description below, it may be suspended vertically or horizontally, and used in single units or in a plurality of units or formed in a honeycomb or other arrangement for the concentration of a number of units in a limited space. The sound absorber is so designed that it may be readily installed and may be readily and easily removed as conditions require it. It is adapted to be manufactured and shipped assembled or in knock-down condition for ready assembly and installation at the point of use. It is readily cleanable and incombustible.

The sound absorber of the present invention is shown in the drawings as of generally diamond cross-section, but it may be fabricated in shapes and sizes of other outlines, such as round, oval, square, octagonal, or such other design as may be required. It utilizes sound-absorbing materials having certain characteristics of accoustic impedance suitable to dissipate sound in the inside chamber which has a definite and predetermined relative volume. The sound waves striking the surface of such material will be in part absorbed thereon and in part allowed to penetrate into the inside volume chamber, wherein additional sound is absorbed. In this manner, in the use of the functional sound absorber of the present invention a greater degree of efficiency may be obtained than through the use of conventional accoustical materials which are limited to their absorption of sound only on the surface area thereof, the remainder of the sound being reflected back into the room.

The functional sound absorber of the present invention, being exposed on all sides thereof to the sound in the areas and leading to the sound dissipating volume chamber, (the sound absorber being freely suspended) builds up an absorption coefficient greater than 100% at frequencies above 250 cycles per second.

The device of the present invention may include an outer impervious casing which is provided solely to retain shape and form, and is perforated as shown in Fig. 9. The sound absorbing material behind the perforated facing may be of glass wool, rock wool, mineral wool, or any other similar material provided the acoustic impedance of the material is properly chosen. In addition the material behind the facing may be a wire screen, a glass cloth, or any fabric having the proper flow resistance. One or more openings may be provided in the sound absorbing material wall to attain a boost effect at low frequencies. The device of the present invention may also be made without an outer perforated impervious facing.

The cleanability feature of the device is of tremendous importance, as dirt, grease, foreign particles in the air and the like adhere to the surface of absorbing materials. The ability to clean it is of importance for continued efficiency in use; one of the features of the sound absorbing device of the invention is the ready accessibility of the unit itself and the ability to replace parts or, by

slight movement or shifting of the sound-absorber walls, to allow entirely new surfaces to be exposed to the openings of the outer facing. Individual walls or other parts of the device may be readily replaced where necessary or desirable.

These and other advantageous objects, which will appear from the drawings and from the description hereinafter, are accomplished by the structure of my invention, of which embodiments are illustrated in the drawings. It will be apparent, from a consideration of said drawings and the following description, that the invention may be embodied in other forms suggested thereby, and such other forms as come within the scope of the appended claims are to be considered within the scope and purview of the instant invention.

In the drawings:

Fig. 1 is an elevational view of a functional sound absorber embodying the invention,

Fig. 2 is a horizontal sectional view thereof, taken on lines **2—2** of Fig. 1,

Fig. 3 is a top plan view of a form of end closure member which may be used with the device;

Fig. 4 is a bottom plan view thereof;

Fig. 5 is a fragmentary sectional view of one form of corner connection means which may be used in fabricating the device;

Fig. 6 is an elevational view of a plurality or sound absorber units embodying the invention, shown suspended in honeycomb relation, in one of the many forms in which a plurality of units of the device may be suspended contiguously or in plural form;

Fig. 7 is a similar view of another arrangement of such units;

Fig. 8 is an elevational view, in modified form, of a functional sound absorber unit wherein a supporting framework is used in place of the outer perforated impervious facing;

Fig. 9 is a fragmentary elevational view taken on line **9—9** of Fig. 1; and

Fig. 10 is a horizontal sectional view of another form of sound absorber embodying the invention.

As shown in the drawings (which as above noted are illustrative only of several forms in which the invention may be embodied), the functional sound absorber of this invention is generally designated by the reference character **10**; in the form shown in Figs. 1 and 2, it includes a form-retaining impervious facing **11** which may be made of metal, plastic, wood or other suitable material of relatively low sound absorption characteristics. The facing **11** may be dispensed with entirely and replaced by suitable supporting framework, as indicated at **12** in Fig. 8. In the form shown in Fig. 1, the form-retaining facing **11** is preferably relatively continuous in one plane, as, for example, in a horizontal plane, and is provided with a plurality of perforations as indicated at **13** in Figs. 2 and 9. The inner wall members **14** of a material such as wire screen glass fibre cloth, glass fibers, rock wool or other sound-absorbing materials, are disposed in the device **10** co-extensive with the facing **11**, and defining therewith a sound-dissipation chamber **15** interiorly of the device for dissipation of sound waves flowing through the walls **14**. The facing **11** is perforated as above noted at **13** to predetermine the flow resistance characteristics of the wall relative to the volume of the chamber **15** for utilization of the relative maximum efficiency of the wall and chamber in their respective sound impedance and dissipation functions.

As shown in Fig. 5, the facing **11** and inner walls **14** may be secured together at each or alternate corners of the sound absorber by corner units **20** which may comprise channel members of generally W-shaped cross-sectional outline presenting opposing channels **21**, **22** to reecive the facing and/or wall members and secure them together. The opposed channel portions **21**, **22** of the corner units may be connected by the wedge-shaped bridge-place **23** to receive the link **24** which projects from the device. By this arrangement, it will be apparent that two or more sound-absorber units may be secured together, and may be suspended from suitable supports or pendants **25**. The arrangement described facilitates the securing together of a plurality of absorber units in honeycomb relation as in Fig. 6 or in the similar relation but

at a different angle as shown in Fig. 7, or in any of an infinite variety of inter-related arrangements found suitable for particular applications.

The device may be manufactured with the end facings for two walls formed unitarily and secured to similar end facings by the corner units **20**. The individual sound-absorbing walls **14** may be similarly fabricated or fabricated as single wall members received within the corner units and thereby secured to the facings in registering relation therewith. By the arrangement described, it will be apparent that the inner walls **14** may be readily shifted from time to time to thereby present fresh portions of the inner walls in registering relation with the perforations of the facings. Likewise, the device may be readily taken apart from time to time for cleaning purposes or to replace any of the parts. End closure members **26, 27** may be provided; said end closure members may likewise be provided with perforations **13'** and panels **28** of sound-absorbing material may be secured to said end closure members. One or more openings (**29, 30**) for boosting the sound absorbing characteristics of the device at low frequencies—particularly for industrial applications, may be provided in the sound absorbing material on the side walls or end panels, as shown in Figs. 1 and 4. The openings **29, 30** are of relatively greater dimensions than the apertures **13, 13'**. Fig. 8 is an illustration of the manner in which the outer facings may be dispensed with if so desired and a framework **12** used instead. In that case, the inner walls **14** are secured directly to the framework **12** and the ends panels **28, 29** are likewise directly secured thereto. The framework **12** may be provided with link member **24'** suitably secured thereto for suspension of the device from the pendants **25'**. The pendants **25, 25'**, it will be understood, are suitable supports such as wire or other pendant means by which the device may be secured to the ceilings, walls, or other supporting means.

Outer facing **11** may be fabricated as a single unit to which the inner sound absorber walls are secured, or as two or more units with means such as indicated at **20** in Fig. 5 to secure the facings and inner walls together. Or they may be made up as side facings of a standard outline of which a number (equal to the number of sides of the unit) would be secured together. An example of this is seen in Fig. 10 wherein individual side facings **31—34** are shown, secured together by means such as corner clamp units **35—38**. In such construction the inner walls **39—42** may be secured to the side facings as by rivet members **43—46** or the like. The ends of the unit may be open or closed, as desired, and other structural features herein described and shown in the drawings in figures other than Fig. 10 may be incorporated where suitable in the construction of the Fig. 10 unit.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:

1. In a sound absorbing device, a sound dissipation chamber formed of sides comprising an outer, form-retaining facing and an inner wall of sound-absorbing material for dissipation of sound waves flowing through said facing and wall, said sound-dissipation chamber sides having a plurality of perforations of substantially small area, to predetermine the flow resistance characteristics of the wall relative to the volume of the chamber, for utilization of the relative maximum efficiency of the wall and chamber in their respective sound impedance and dissipation functions, and having at least one opening of relatively greater dimensions than said perforations to define a resonant opening for enhancing the sound absorption characteristics of the device at low frequencies.

2. In a sound absorbing device as set forth in claim 1, said inner wall being co-extensive with said facing.

3. In a sound absorbing device as set forth in claim 2, means to secure said outer facing and inner wall together in co-extensive relation.

4. In a sound absorbing device as set forth in claim 1, end closure members secured to said sound dissipation chamber sides and closing said chamber.

5. In a sound absorbing device, a sound dissipation chamber formed of sides, each side comprising an outer, form-retaining facing and an inner wall of sound absorbing material for dissipation of sound waves flowing through said facing and wall, said sound-dissipation chamber sides having a plurality of perforations of substantially small area, to predetermine the flow resistance characteristics of the wall relative to the volume of the chamber, for utilization of the relative maximum efficiency of the wall and chamber in their respective sound impedance and dissipation functions, end closure members secured to said sound dissipation chamber sides and closing said chamber, and including co-extensive inner walls of sound absorbing material secured to said end closure members, said end closure members and sides having at least one opening of relatively greater dimensions than the dimensions of the facing perforations, to define a resonant opening for enhancing the sound absorption characteristics of the device at low frequencies.

6. In a sound absorbing device as set forth in claim 5, said inner wall of the side members being co-extensive with said facing.

7. In a sound absorbing device, a sound dissipation chamber formed of two side sections, each section comprising an outer form-retaining facing and a co-extensive inner wall of sound absorbing material for dissipation of sound waves flowing through said facing and wall, said sound-dissipation chamber sides having a plurality of perforations of substantially small area, to predetermine the flow resistance characteristics of the wall relative to the volume of the chamber, for utilization of the relative maximum efficiency of the wall and chamber in their respective sound impedance and dissipation functions, said sections having at least one opening of relatively greater dimensions than said perforations to define a resonant opening for enhancing the sound absorption characteristics of the device at low frequencies, and means to secure said sections together.

8. In a sound absorbing device, a sound dissipation chamber formed of two side sections, each section comprising an outer, form-retaining facing and a co-extensive inner wall of sound absorbing material for dissipation of sound waves flowing through said facing and wall, said sound dissipation chamber sides having a plurality of perforations of substantially small area, to predetermine the flow resistance characteristics of the wall relative to the volume of the chamber, for utilization of the relative maximum efficiency of the wall and chamber in their respective sound impedance and dissipation functions, end closure members secured to said sound dissipation chamber sides and closing said chamber and co-extensive inner walls of sound absorbing material secured to said end closure members, said end closure members and sides having at least one opening of relatively greater dimensions than the dimensions of the facing perforations, to define a resonant opening for enhancing the sound absorption characteristics of the device at low frequencies and means to secure said sections together.

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