March 30, 1971 E. R. WITKOSKY ET AL 3,573,145

PORTABLE SOUND ATTENUATING PARTITION WALL PANEL

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Fig.2.

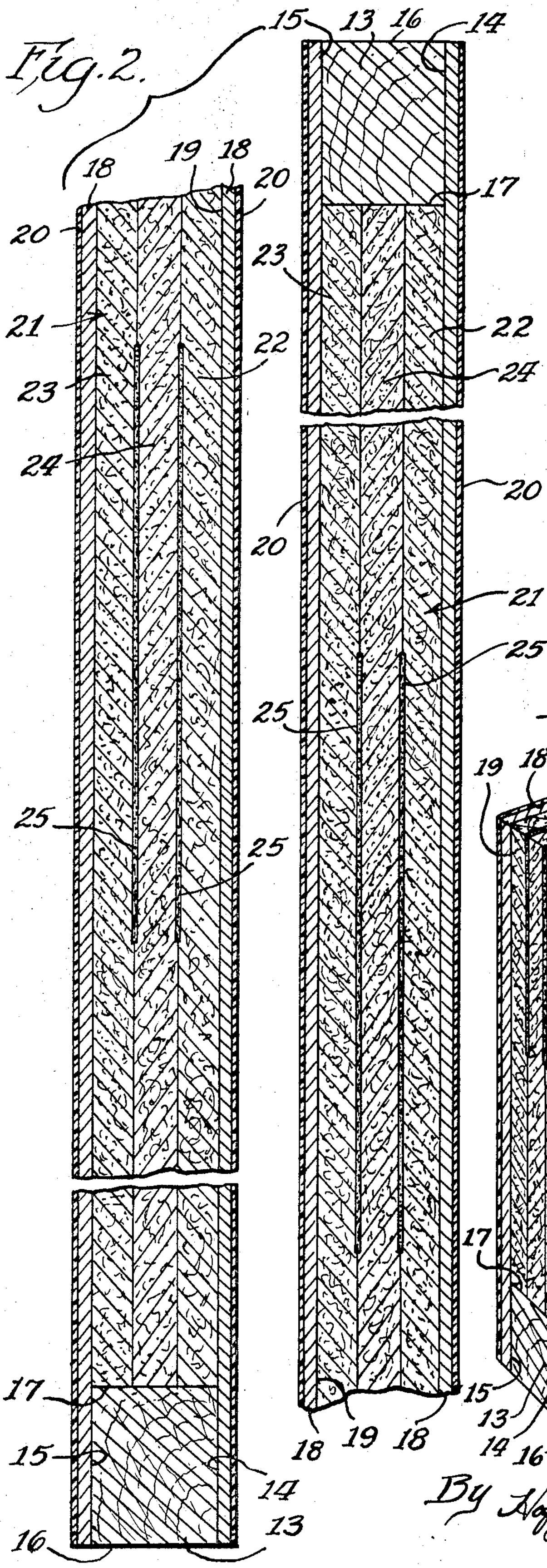


Fig.1.

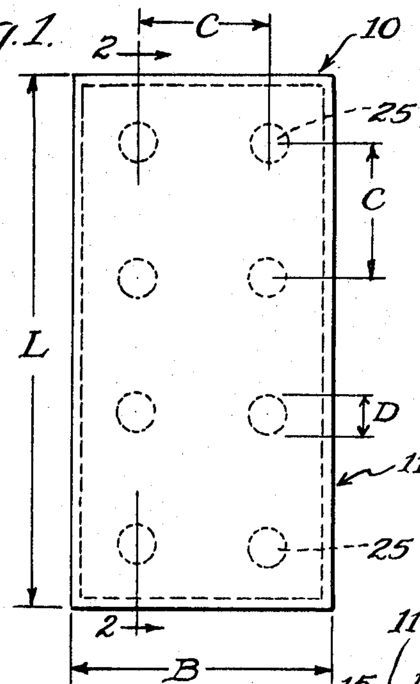
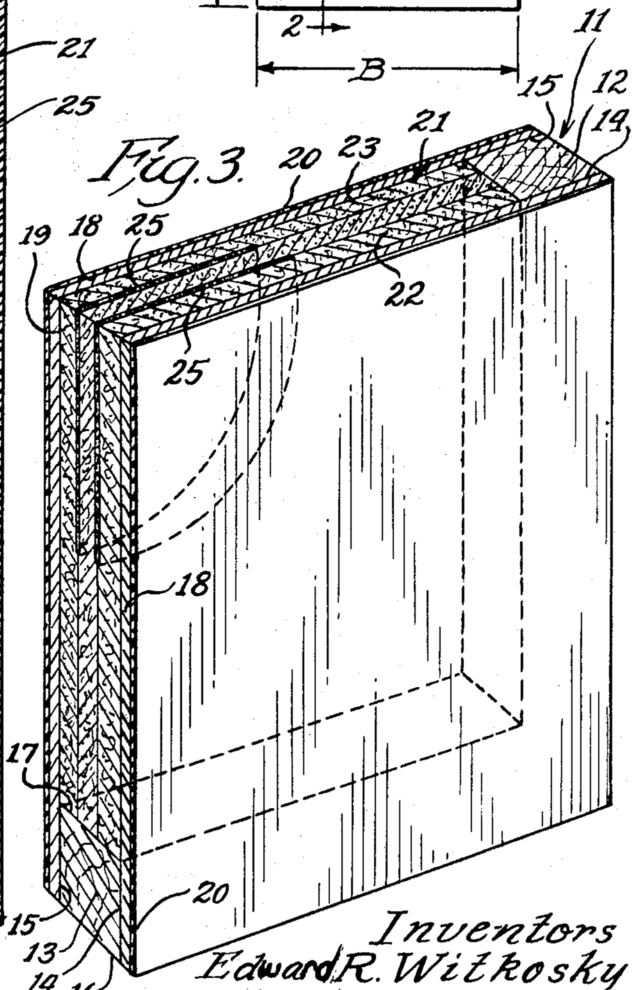


Fig.3.



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PORTABLE SOUND ATTENUATING PARTITION WALL PANEL

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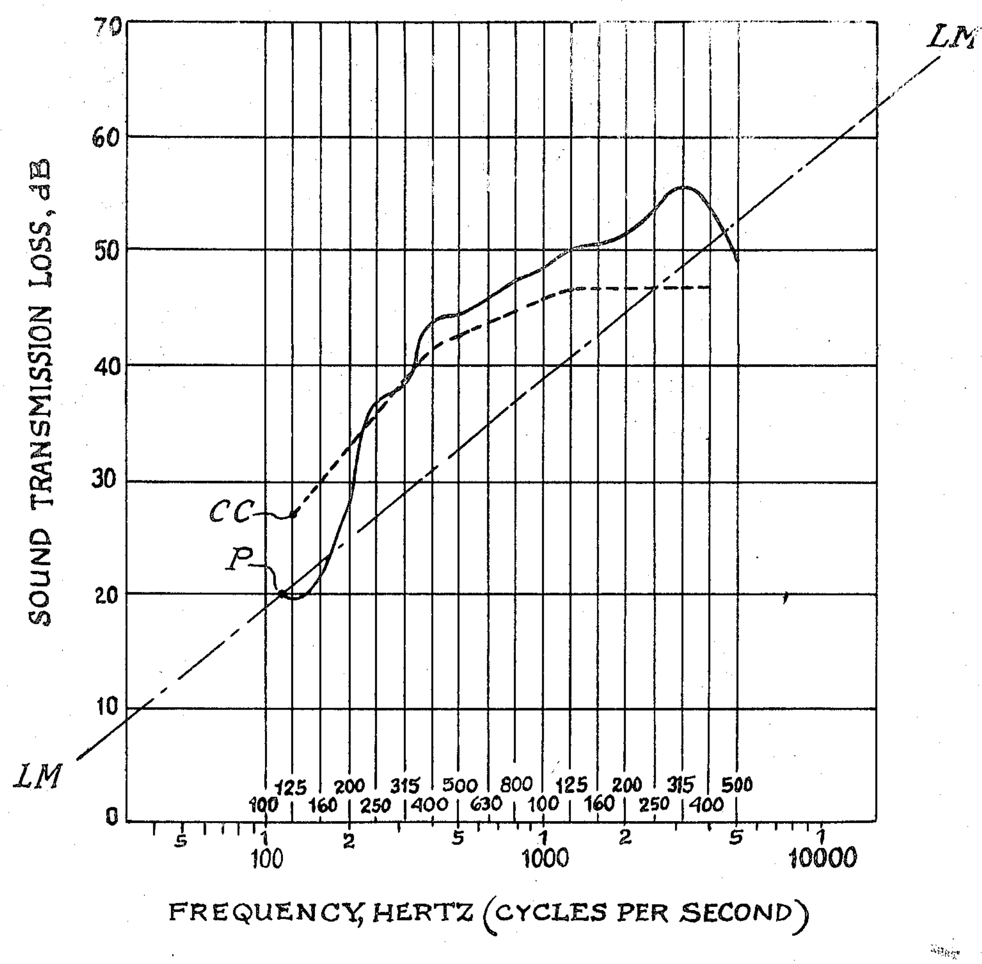
Fig. 4.



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PORTABLE SOUND ATTENUATING PARTITION WALL PANEL

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U.S. Cl. 161—41 9 Claims

ABSTRACT OF THE DISCLOSURE

A portable room divider panel of high sound attenuating characteristics, the panel having a wood frame, a sheet of low pressure laminate hardboard bonded to each face of the frame to form a chamber, a decorative skin of high pressure laminate bonded to each sheet of hardboard, and a core in the chamber consisting of three laminar mineral fiber boards of which a one inch thick section weighs about 0.9 pound per square foot, the boards being secured to one another by widely spaced spots of adhesive which occupy a minor fraction of the surface area of the core. The core fills the chamber and affords structural support for the hardboard sheets without being compressed by the sheets. A four by eight foot panel which is one and three-quarters inch thick and weighs 125 pounds has an overall sound transmission class of about 43 when tested in accordance with ASTM specification E90–66T.

BACKGROUND OF THE INVENTION

Modern office or commercial buildings generally have large open floor areas with the only permanent walls surrounding the floors and separating public facilities and service areas from the office or commercial space. Such a large open floor area is then divided to suit the occupant of the floor by means of plaster block walls or portable partition panel walls.

Portable partition panel walls are much more desirable than plaster block walls from the viewpoint of easy erection and removal; but such walls generally afford inadequate sound attenuation between rooms unless the panels are undesirably thick and heavy.

Thus, a major effort in the design of portable partition panels has been to make them thin, light in weight, rigid, and still give them adequate sound attenuating characteristics so that ordinary noises in one room will not penetrate to an adjoining room at an objectionable level.

Further obvious requisites of such panels are that they have hard, abrasion resistant surfaces which also resist denting, puncturing, and other types of damage which result from normal abuse in use.

A basic problem in the design of portable wall panels is that generally if they are rigid and have a hard, damage resistant surface they also transmit sound well unless they are very thick or heavy.

SUMMARY OF THE INVENTION

The present invention provides a portable wall panel which is rigid and has highly damage resistant faces. The panels are only 1.75 inches thick and weigh about 3.9 pounds per square foot; so that a 4 foot by 8 foot panel weighs only 125 pounds and may be easily handled by one man.

In spite of its extreme thinness and light weight, such a 4 foot by 8 foot panel has a sound transmission class (STC rating) of 43 when tested in conformity with ASTM specification E90–66T.

By comparison, a six inch thick, dense concrete block wall, weighing 43 pounds per square foot, has about the same STC rating.

Most panels exhibiting comparable acoustical performance are 3 to 4 inches thick, or are extremely heavy.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a front elevational view of a panel embodying the invention;

FIG. 2 is a broken, longitudinal sectional view taken substantially as indicated along the line **2—2** of FIG. 1;

FIG. 3 is a perspective view of a section sawed out of one corner of a panel; and

FIG. 4 is a sound transmission loss curve for a panel embodying the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the drawings, a portable wall panel **10** embodying the invention is conveniently 4 feet broad by 8 feet long, so that its length is about equal to room height in a modern office or commercial structure, or it may be mounted with its long dimension horizontal in installations which include a glazed wall section of equal length. The panel may be adapted to any of a variety of systems for supporting room divider panels; but is especially designed for use with the system disclosed and claimed in our application Ser. No. 717,489, filed Apr. 1, 1968. For adaptation to that system the longitudinal frame sides are continuously grooved to receive mounting flanges as disclosed in said application.

In the specific embodiment here shown, a rectangular wood frame, indicated generally at **11**, includes longitudinal frame members **12** and transverse frame members **13** which are fabricated from dressed 1⅜ inch lumber (actual finished thickness 1$\frac{5}{16}$ inch) between the front and rear frame faces **14** and **15**, and nominally 1⅝ inches (dressed 1$\frac{17}{32}$ inches) wide from the outer frame face **16** to the inner frame face **17**. The frame has an outside length L of 8 feet and an outside breadth B of 4 feet (FIG. 1).

Bonded to the front and rear faces **14** and **15** of the frame are ⅛ inch thick sheets **18** of low pressure laminate untempered hardboard such as Customite (Pope Talbot Co.), Masonite (Masonite Corp.) or equivalent. The hardboard sheets **18** cooperate with the frame **11** to form a closed chamber **19**. Covering the entire hardboard sheets **18**, and continuously bonded to said sheets, are $\frac{1}{16}$ inch thick decorative skins **20** of high pressure laminate such as Formica or equivalent. Such high pressure laminate commonly consists of seven layers of resin impregnated kraft paper, a decorative resin layer, and transparent melamine resin protective layer.

Within the chamber **19** is a core, indicated generally at **21**, which consists of three laminar mineral fiber boards including outer boards **22** and **23** and a central board **24** which are in facing relationship. Widely spaced spots **25** of polyvinyl adhesive secure each of the outer boards **22** and **23** to the central board **24**, and as seen in FIGS. 2 and 3 such spots are aligned on opposite surfaces of the central board. Referring to FIG. 1, the adhesive spots have a diameter D which is one-fourth of their inter-center spacing C; and for the particular panel here illustrated the spots **25** are substantially circular, with a D of 6 inches and a C of 24 inches. The spots on one face of the central board **24** occupy only a minor fraction of the total area of the core surface. In the specific structure illustrated the adhesive area is of the order of 35% of the core surface area.

The core material boards **22**, **23** and **24** are $\frac{7}{16}$ inch thick and weigh approximately .39 pound per square foot, so that a square foot of the material 1 inch thick has a weight of .8987 pound per square foot. The three boards forming the core weigh 1.1796 pounds per square foot. The mineral fiber of the boards is of such fiber size, length, and orientation as to provide a high level of sound damping and sound absorption. A suitable mineral fiber board is available from Owens-Corning Fiberglas Supply Division as its fiberglass noise stop board.

The previously stated dimension of the wood frame and the core board shows that the total thickness of the core is 1/16 inch less than the space between the hardboard sheets **18**, so that although the core provides good structural support for the hardboard it is not compressed between the sheets. As a result, the core maintains the full sound absorption and damping capacity of the individual boards.

FIG. 4 of the drawings is a sound transmission loss curve for a specimen panel constructed in accordance with the present disclosure, when tested by a method and using facilities which conform explicitly to the specification of ASTM E90–66T. This is a standard specification for measuring sound transmission in sound attenuating materials.

In FIG. 4, the solid line P is the sound transmission loss curve of the panel of this invention, while the broken line CC is the limiting sound transmission class contour for a material to fall in sound transmission class **43**. The straight line LM is the theoretical transmission loss of a limp mass having the same weight per square foot as the panel—i.e., in this case 3.9 pounds per square foot average, taking the total 125 pound weight of a panel and dividing it by the 32 square feet of panel surface.

The sound transmission loss curve for the present panel is of substantial interest, because it shows that at all frequencies above about 225 cycles per second the transmission loss is equal to or substantially better than the limiting sound transmission class contour for STC **43**. Only in the range between approximately 100 and 225 cycles per second does the curve fall below the limiting sound transmission class contour, and that is entirely below the normal voice range.

The theoretical transmission loss line LM of a limp mass having the same weight per square foot as the present panel is derived from the equation:

$$TL=20\log W+20\log F-33$$

where W is weight in pounds per square foot, and F is frequency in Hertz (cycles per second).

As previously indicated the sound transmission loss curve for the present panel is most extraordinary for a panel of such light weight and thinness. The STC rating is about the same as that of a 6 inch thick dense concrete block wall weighing 43 pounds per square foot. Most panels which exhibit acoustical performance in the same STC as the present panel are either two to three times as thick or else they are extremely heavy.

The line LM in FIG. 4 shows that a solid panel of equal weight, if acting as an ideal limp mass, would carry an STC rating of about 33 to 35. However, most ordinary building materials in monolithic slabs of such weight would have a much lower rating—probably between STC 26 and STC 30, or thereabouts, because of coincidence effect.

An expert analysis of the panel, without running actual tests, suggests that such a panel without the particular core **21** here disclosed probably would have an STC rating of 33 to 35 or less.

The transmission loss curve P shows that the panel exhibits a true "double wall" performance in which the walls consisting of the hardboard sheets **18** and high pressure laminate skin **20** act independently of each other, as if they were not connected in any way. In order for them to do so, the core must have great acoustical "limpness."

The precise reasons for the extraordinary sound transmission loss provided by the panel of the invention are not entirely known. It is believed, however, that an important factor is the use of a plurality of laminar mineral fiber boards in the core, and securing the boards together by widely spaced spots of adhesive. It is thought that the spot gluing of the boards to one another is particularly significant in damping harmonic resonances in the core which normally evidence themselves as small dips in the transmission loss curve for double-wall constructions. In addition, the fact that the core thickness is substantially equal to but no greater than the space between the hardboard sheets **18**, so that compression of the boards is avoided, it is also believed to be an important feature of the invention.

The foregoing detailed description is given for clearness of understanding only and no unnecessary limitations should be understood therefrom, as modifications will be obvious to those skilled in the art.

We claim:

1. A portable room divider panel of high sound attenuating properties, said panel comprising, in combination:
- a rectangular frame formed of relatively narrow material having a front face and a rear face, the outside length of said frame being about room height and the outside breadth being about half the length;
- a rectangular sheet of low pressure laminate hardboard bonded to the front and rear faces of the frame to provide a closed chamber; and
- a core in said chamber comprising a plurality of laminar mineral fiber boards of which a one inch thick sections weighs about 0.9 pound per square foot, the fibers of said boards being of a size, length and orientation to provide a high level of sound damping and sound absorption, said boards being secured together by a plurality of spaced spots of adhesive the total area of which between any two facing boards is a minor fraction of the surface area of the core, said core filling the chamber and providing structural support for said sheets without being compressed by the sheets;
- said panel weighing no more than about four pounds per square foot and being less than two inches thick, and such a panel of thirty two square foot area having an STC of about 43 when tested in accordance with ASTM specification E90–66T.

2. The panel of claim **1** which includes a skin of high pressure laminate entirely covering and completely bonded to each sheet of hardboard.

3. The panel of claim **1** which is 4 x 8 feet with uniformly spaced adhesive spots about 6 inches in diameter and having their centers about 24 inches apart.

4. The panel of claim **1** in which the area of adhesive is of the order of 35% of the surface area of the core.

5. The panel of claim **4** in which the adhesive spots are substantially circular and in which the distance between spot centers is about four times the diameter of the spots.

6. The panel of claim **1** in which the core consists of two outer boards and a central board, and in which the outer boards are secured to the central board by spots of adhesive which are aligned on opposite surfaces of the central board.

7. The panel of claim **6**, in which the area of adhesive is of the order of 35% of the surface area of the core.

8. The panel of claim **7** in which the adhesive spots are substantially circular and of substantially uniform diameter, and in which the distance between spot centers is about four times the diameter of the spots.

9. A portable room divider panel of high sound attenuating properties, said panel comprising, in combination:
- a rectangular wood frame which is about one and three eighths inches thick from its front face to its rear face, the outside dimensions of said frame being about four feet by eight feet;
- a one-eighth inch thick rectangular sheet of low pressure laminate hardboard bonded to each face of the frame to form a closed chamber;
- a one-sixteenth inch thick skin of high pressure laminate entirely covering and continuously bonded to each sheet of hardboard, there being a decorative surface on each skin; and

a core in said chamber consisting of two outer laminar mineral fiber boards and a central laminar mineral fiber board, the thickness of said core being substantially equal to but no more than the space between the hardboard sheets, and said core weighing about 1.18 pounds per square foot, the fibers of said boards being of a size, length and orientation to provide a high level of sound damping and sound absorption, said outer boards being secured to said central board by generally evenly spaced generally round spots of adhesive the total area of which on either face of the central board is of the order of 35% of the surface area of the board, with the distance between centers of the spots being about four times their diameter; said panel weighing no more than about four pounds

per square foot and having an STC of about 43 when tested in accordance with ASTM specification E90-66T.

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52—309; 161—148; 181—33