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REMOVABLE PARTITION WALLS

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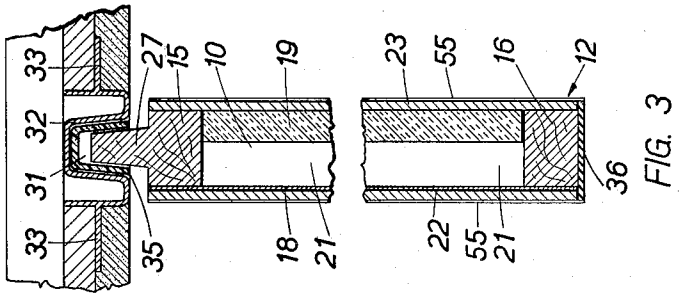


FIG. 3

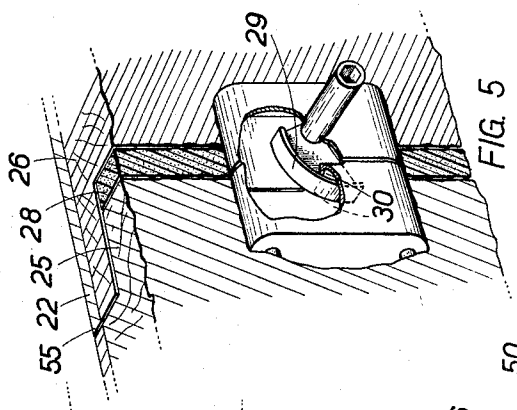


FIG. 5

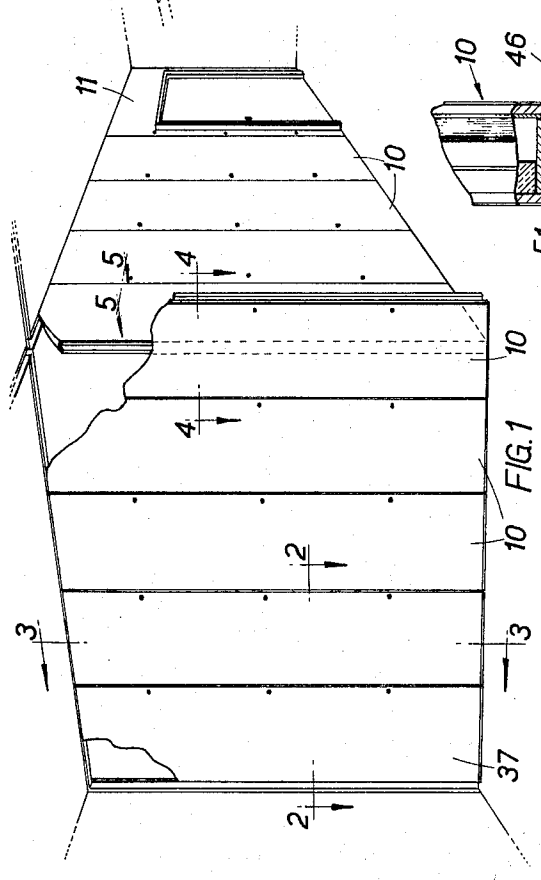


FIG. 1

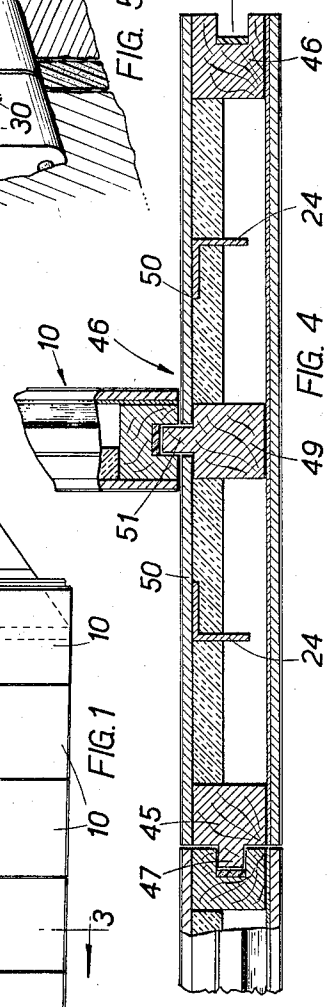


FIG. 4

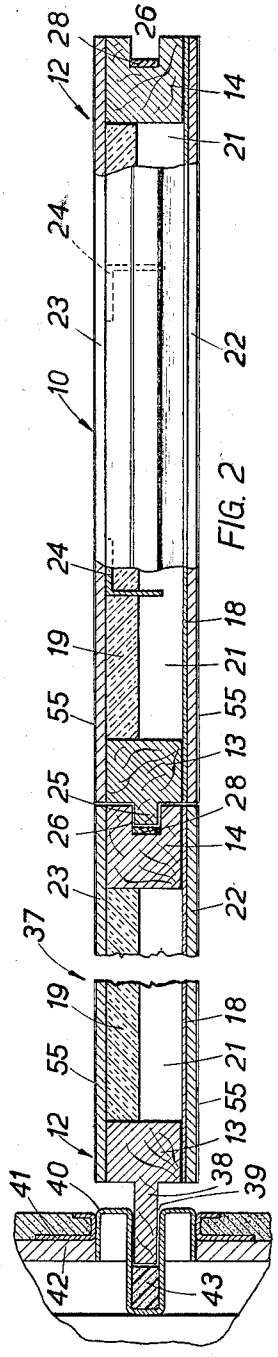


FIG. 2

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REMOVABLE PARTITION WALLS

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This invention relates to sound insulating partition walls. It is particularly directed to self-supporting sound absorbing and insulating panel constructions which can be interconnected to form effective sound attenuating partition wall structures.

Prefabricated sectional partition panels are well known and widely used in floors and interior walls of buildings for temporary or semi-permanent subdivision of building interior space into offices, convention rooms, auditoriums and the like. Heretofore, sectional partion panel constructions have had several inherent disadvantages which have largely precluded ready public acceptance and use. For example, most partition panels are extremely cumbersome and too heavy for convenient ease of handling and portability. The locking mechanisms necessary to secure the panels together to form a unitary structure are relatively complex requiring considerable time for erection or dismantling. Where it is desired to obtain optimum sound attenuation characteristics, conventional panels either provide insufficient sound absorbing and insulating characteristics to be practicable or, conversely, if they are provided with sufficient sound absorbing and insulating material to be efficient, are too heavy and cumbersome to be practical.

Sound insulation for normal commercial and industrial purposes is usually directed to the frequency range of from about 125 to about 4,000 cycles per second (c.p.s.) in that although the human ear may be capable of hearing sounds over a frequency range of from about 20 to about 20,000 c.p.s., the frequencies between 125 and 4,000 c.p.s. sound louder than frequencies at equal intensities above and below this sound range. Portable light-weight panels heretofore have provided insufficient sound insulation, that is, insufficient resistance to sound transmission, to be effective due to a lack of mass and due to a resonance occurring within the panel within the critical frequency range of 125 to 4,000 c.p.s. The resonance results from flexural vibration of the barrier itself set up by incidental sound waves and is dependent on the mass and construction of the barrier as well as the frequency of the sound. The rigidity necessary to support the light-weight panel usually places the resonance of the panel within the objectionable range.

We have discovered that a novel combination of a thin lead sheet with a porous sound absorbing material arranged in spaced relation one to the other within a rigid wall structure provides efficient sound absorbing and insulating properties permitting the facile use of portable light-weight prefabricated panel constructions in partition wall structures.

It is, therefore, a principal object of our invention to provide a novel panel construction which has effective sound absorbing and insulating properties together with light-weight portability.

It is another object of the present invention to provide a panel construction which will provide uniformly effective sound attenuating properties over the frequency range of 125 to 4,000 c.p.s.

It is still another object of the present invention to provide a plurality of panel constructions which can be arranged to co-act with each other to form a rigid self-supporting partition wall structure which retains the sound attenuating characteristics of the individual panels that constitute the said wall structure to provide an effective sound barrier.

Another object of the present invention is the provision of a partition wall structure assembly which can be quickly and readily assembled for use and dismantled for storage.

These and other objects of the present invention and the manner in which they can be attained will become apparent from the following detailed description, reference being had to the accompanying drawing, in which:

FIGURE 1 is a perspective view of a partition wall assembly embodying the structure of the present invention;

FIGURE 2 is a transverse section taken along the line 2—2 of FIGURE 1 illustrating the connections made between adjacent panel constructions constituting the wall structure and the connection made between the partition wall structure and abutted permanent wall;

FIGURE 3 is a longitudinal section taken along the line 3—3 of FIGURE 1 illustrating the connection between the panel constructions of the partition wall and ceiling;

FIGURE 4 is a transverse section taken along the line 4—4 of FIGURE 1 illustrating the connection between two intersecting partition wall structures; and

FIGURE 5 is a transverse section taken along the line 5—5 of FIGURE 4 illustrating a locking mechanism employed to secure the panels together.

Like reference characters refer to like parts throughout the description of the drawing.

The partition wall assembly of the present invention illustrated generally by FIGURE 1 comprises a plurality of panels **10** adapted to be interlocked one with another to form a continuous and substantially air-tight and soundproof partition wall structure **11**. Each of the panels **10** comprises a framework **12** having a pair of spaced, longitudinal post members **13** and **14** and a pair of spaced, transverse connecting head and foot members **15** and **16**. The central opening defined by the framework **12** is closed on one side by a sheet **18** of a limp, heavy material such as sheet lead or woven lead and lead impregnated cloth fabrics which preferably is co-extensive with the outer edge of the framework.

The opposite side of the panel opening preferably is closed by a layer **19** of porous material such as cellular plastic or fiberglass which may be secured along each edge to the interior of framework **12**. A space **21** substantially co-extensive with the aforesaid panel opening preferably is formed between sheet **18** and layer **19** for reasons which will become apparent as the the description proceeds. Although space **21** is shown defined between sheet **18** and layer **19**, it will be understood that this arrangement is illustratory only of the structure of the present invention and space **21** could be formed on the opposite side of layer **19** by abutting layer **19** against sheet **18**.

A rigid sheet **22** secured to one side of framework **12** by nails, screws or the like securing means is adapted to enclose lead sheet **18** and co-act with the side of the framework **12** to tightly engage the edges of the lead sheet therebetween. Rigid sheet **23** likewise secured to the opposite side of the framework **12** by nails, screws or the like securing means preferably is adhesively secured

to one face of the porous material. The lead sheet and porous material are thus supported within the panel construction. The rigid sheets interact with the framework to provide a self-supporting structural panel unit.

To provide lateral rigidity to each panel, it may be preferred to incorporate an angle member **24** longitudinally within each panel whereby the angle is secured to head and foot members **15** and **16**.

Each of longitudinal members **13** is provided with a tongue **25** along its exposed edge and each of longitudinal members **14** is provided with a tongue receiving groove **26** along its exposed edge. Header frame member **15** has a tapered tongue **27** formed along its exposed edge, as most clearly illustrated in FIGURE 3.

With reference to FIGURES 1, 2 and 3, it will be evident that the panels **10** are arranged in an edge-to-edge abutting relationship when erected to form a continuous partition wall. Tongue **25** of each longitudinal frame member **13** is inserted in groove **26** of opposed longitudinal member **14** of the next adjacent panel. Gasket material **28** disposed within each groove **26** is of sufficient thickness to be compressed by tongue **25** to provide an effective air-tight seal. To ensure maintenance of an air-tight connection between the abutting panels, a plurality of locking devices preferably are positioned at intervals along the longitudinal edges of the panels for locking the panels together. Each lock comprises a rotatable flanged cam latch member **29** pivotally mounted in one edge of a panel and a lug or pair of lugs **30** rigidly secured to the opposing edge of the adjacent panel adapted to receive said flanged cam latch. The flanged cam latch and lugs interact to draw tongue **25** into groove **26** and tightly compress gasket matreial **28** therebetween, as shown in FIGURE 5.

Tongue **27** formed in header **15** is received within a groove **31** formed longitudinally in elongated, rigid member **32** secured to the ceiling of the room by means of flanges **33** extending therefrom connected to a ceiling beam. A rubber lining **35** seated in groove **31** is adapted to be compressed by tongue **27** when panel **10** is positioned in its vertical position to effect an air-tight seal therebetween. A dense rubber strip **36** secured to the exposed edge of foot member **16** is compressed by the weight of the panel to effect an effective air-tight seal between the floor and the panel.

Terminal or end panel **37** has a tongue **38** formed along the exposed edge of longitudinal side member **13** adapted to be inserted into recess **39** formed in a vertically disposed member **40** secured to a permanent wall of the room. Member **40** is rigidly secured to the room wall by means of a pair of flanges **41** having securing means driven therethrough into wall post **42**. A resilient compressible material such as foam rubber **43** is seated within recess **39** such that said rubber is compressed by tongue **38** when the panels are in their installed positions.

FIGURE 4 illustrates another embodiment of panel construction having a pair of longitudinal side members **45** and **46** formed with longitudinal tongues **47** and grooves **48** as has been described hereinabove. A longitudinal intermediary member **49** disposed centrally within panel **46** is adapted to extend through external sheet **50** and provide a longitudinally extending lateral tongue **51** as illustrated. It will be evident from FIGURES 1 and 4 that panels **10** can be arranged to abut and receive tongue **51** of panel **46** for wall arrangements within room areas.

The exterior surfaces of the rigid outer sheets **22** and **23** preferably are coated with a thin layer of a veneering material such as polyvinyl chloride or the like fabric **55** to provide an aesthetic appearance to the panels and to match the decor of the room in which the partition wall is assembled.

To install the partition wall structure, panel **37** normally is first placed into position by inserting tongue **27** in ceiling groove **31**, positioning the panel vertically, and sliding the panel such that longitudinal tongue **38** is received in vertical groove **39**. Allowing space for the next adjacent panel **10**, the remaining panels **10** are raised into a substantially vertical position, tongues **27** inserted into grooves **31**, and the panels connected into a tight fitting abutting relationship by means of the locking devices. The panel adjacent to terminal panel **37** is last installed in position by forcing panel **37** to the left as viewed in FIGURE 1 to compress foam rubber gasket **43**, positioning panel **10** adjacent to panel **37**, and then forcing panel **37** to the right as viewed in FIGURE 1 such that it abuts in tight fitting relationship and is locked with said adjacent last-installed panel **10**. Foam rubber gasket **43** expands to fill recess **39** and maintain a substantially air-tight connection between the partition wall **11** and the permanent wall.

Although it will be understood the present invention is independent of hypothetical considerations, it is believed the improved sound attenuating characteristics of our panel construction result from the limp lead sheet dampening the amplitude and/or frequency of vibration of one rigid outer sheet and the layer of porous material adhesively secured to the other outer sheet dampening the amplitude of vibration of the second outer sheet such that the two opposed rigid sheets vibrate at different resonant frequencies thereby cancelling reflected and transmitted sound waves within the air space defined within the panel construction by the porous material on the one side and the heavy lead sheet on the other. The porous material arranged to form one side of the enclosed air space or disposed within the air space absorbs much of the sound energy not cancelled by the two plies vibrating at different frequencies. Thus the resonant frequency is considerably elevated and the effect of the resonance, if present within the frequency range of 125 to 4,000 c.p.s., considerably minimized.

The following example illustrates the construction of individual panels incorporated into a partition wall structure and the sound attenuating characteristics provided thereby. Twenty-six panels each 2′ wide and 12′-1″ long were arranged in a vertical, side-to-side abutting relationship to form a partition wall 54′-0″ long and 12′-1″ high disposed across a room 83′-6″ long, 54′-0″ wide and 12′-1″ high; dividing the room into two halves. Each panel consisted of a rectangular framework of 2″ x 2″ wooden members having a sheet of 1/64″ thick lead underlying a ¼″ thick sheet of plywood rigidly secured to one side of the framework and a 1″ thick layer of fiberglass cemented to the inside face of a ¼″ thick sheet of plywood which was rigidly secured to the opposite side of the said framework. The exterior surfaces of the two plywood sheets were covered with a thin coating of vinyl fabric.

Flanged cam locks were employed to rigidly secure the panels together such that a tongue formed in the longitudinal edge of one panel abutted and compressed a rubber gasket seated in the groove formed in the opposing edge of the next adjacent panel. Foam rubber gasket material was employed to seal the joints between the partition wall and the permanent wall. Closed-cell neoprene rubber was employed to effect an air-tight seal between the partition wall and floor and ceiling.

Sound insulation field tests were conducted on this wall assembly in accordance with the technique specified in A.S.A. Standard Z 24.19–1957, whereby a cone-type loudspeaker was mounted 10′ from the partition wall facing away from the wall and a signal produced by a warble tone oscillator using an 8 c.p.s. warble with a modulation of 1/6 octave up to a maximum modulation of 200 c.p.s. Sound intensity readings for a plurality of frequencies in the range between 125 and 4,000 c.p.s. were observed at several points on the sound source side and the receiving room side of the partition wall and the several readings for each frequency averaged to provide the mean sound intensity on each side of the wall. The sound insulation,

in decibels, provided by the partition wall for the several frequencies tested, is shown in the following table.

Table 1

Frequency, cycles/second:	Insulation, decibels
125	14
175	16.5
250	22
350	27
500	34
700	33
1000	36
2000	38
4000	43

This example clearly illustrates the effectiveness of the partition wall structure as a sound barrier in attenuating sound intensities between the frequency range of 125 to 4,000 c.p.s. The average sound attenuation over the frequency range of 125 to 4,000 c.p.s. is 29 decibels.

The present invention provides a number of important advantages. Heavy lead sheets can be incorporated in prefabricated, light-weight portable panel constructions which can be readily assembled to provide an efficient sound attenuating partition wall structure or disassembled for storage. The combination of heavy, limp sheet material such as lead with a rigid supporting member spaced from a porous sound absorbing material secured to a second rigid supporting member provides a unitary, self-supporting structure having improved sound attenuating characteristics. The resonance of the wall structure is raised to a frequency range which is not irritating to the ear. The partition wall dampens and/or cancels the intensity or amplitude of vibrations impinged on one rigid outer sheet before transmission to the opposed rigid outer sheet. The panels can be manufactured for room heights and wall spans heretofore not practicable and assembled or disassembled quickly, readily and positively.

It will be understood, of course, that modifications can be made in the preferred embodiments of the invention described and illustrated herein without departing from the scope and purview of the invention as defined by the appended claims.

What I claim as new and desire to protect by Letters Patent of the United States is:

1. A panel construction of the type used as a sound barrier comprising, in combination, a planar reinforcing framework defining an opening therein, at least one lead sheet substantially co-extensive with said framework secured to one side of said framework, at least one layer of a porous material substantially co-extensive with the framework opening disposed within said opening such that a space is defined between said lead sheet and said porous material, a pair of rigid sheets substantially co-extensive with said reinforcing framework rigidly secured thereto, one of said sheets abutting the lead sheet and the other of said sheets abutting the layer of porous material, means for adhesively securing said porous material to the abutting sheet, a tongue formed along one longitudinal edge of said framework and a groove formed along the opposite longitudinal edge of said framework, and gasket material disposed in said groove.

2. A panel construction of the type used in a sound barrier comprising, in combination, a planar reinforcing framework defining an opening therein, at least one lead sheet substantially co-extensive with said framework secured to one side of said framework, a layer of porous material substantially co-extensive with the framework opening disposed within said opening such that a space is defined between said lead sheet and said porous material

a pair of rigid sheets substantially co-extensive with said reinforcing framework rigidly secured to said framework along each edge forming a rigid, unitary self-supporting structure, said lead sheet adapted to abut the interior surface of one of said rigid sheets and the porous material adapted to abut and be adhesively secured to the interior of the other of said rigid sheets, a tongue formed along one exposed longitudinal edge of said framework and a groove formed along the opposite longitudinal edge of said framework, and a compressible material disposed in said groove along the length of said groove.

3. A panel construction as claimed in claim 2 in which said porous material is selected from the group consisting of cellular plastic and glass fiber.

4. A panel construction as claimed in claim 3 in which a tongue is formed along one transverse edge of said panel.

5. A sectional partition structure for dividing room space which comprises a plurality of elongated panels each having a planar reinforcing framework defining an opening therein, at least one lead sheet substantially co-extensive with said framework secured to one side of said framework, at least one layer of a porous material substantially co-extensive with the framework opening disposed within said opening such that a space is defined between said lead sheet and said porous material, a pair of rigid sheets substantially co-extensive with said reinforcing framework rigidly secured thereto forming a rigid, unitary self-supporting structure, said lead sheet adapted to abut the interior surface of one of said rigid sheets and the porous material adapted to abut and be adhesively secured to the interior of the other of said rigid sheets, a tongue formed along one longitudinal edge of each of said panels and a groove formed along the opposite longitudinal edge of each of said panels adapted to receive the tongue of the next adjacent panel, gasket material disposed in each of said grooves adapted to be compressed by a tongue of the next adjacent panel to provide a substantially air-tight seal between each panel, and a tongue formed in the framework at one end of each of said panels adapted to be inserted and received in a recess formed in the ceiling of the room for making an air-tight connection therewith.

6. In a sectional partition structure as claimed in claim 5, a wall having an elongated recess adapted to receive a tongue formed in a longitudinal edge of a panel, said recess having sufficient depth to permit the panel tongue to be displaced laterally therein, and means for providing an air-tight connection between said panel tongue and said wall.

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