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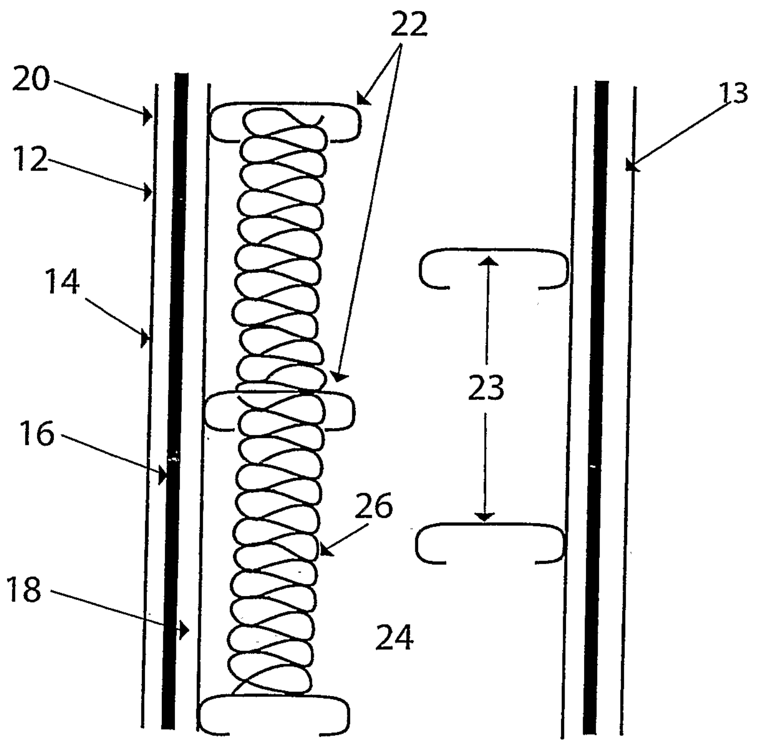
(54) Title: CONSTRUCTION ELEMENTS



(57) Abstract: According to one aspect of the present invention there is provided an acoustic laminate suitable for use in wall, floor and ceiling assemblies and other dividing structure assemblies, the laminate including: a viscoelastic acoustic barrier being in the form of discrete, spaced apart sections or a continuous layer; and a construction panel, the barrier affixed to one or more panel faces of the construction panel.

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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

SOUND TRANSMISSION REDUCING CONSTRUCTION ELEMENTS

Field of the Invention

This invention relates to construction elements suitable for use in constructing internal or external walls, ceilings, roofs, floors and the like - where reduction of transmission of sound from one side to another is important.

Background to the invention

The sound transmission loss of a wall partition, ceiling, roofs or floor are determined by physical factors such as mass and stiffness. A complex interplay of factors works to prevent or allow the transmission of sound through surfaces. In a double layer assembly, such as plasterboard on wood or metal framing, the depth of air spaces, the presence or absence of sound absorbing material, and the degree of mechanical coupling between layers critically affect sound transmission losses.

The mass per unit area of a material is the most important factor in controlling the transmission of sound through the material. The so-called mass law is worth repeating here, as it applies to most materials at most frequencies:

$$TL = 20 \log_{10}(m_s f) - 48.$$

where: TL = transmission loss (dB)
m_s = mass per unit area (kg/m^2)
f = frequency of the sound (Hz)

Stiffness of the material is another factor which influences TL. Stiffer materials exhibit "coincidence dips" which are not explained by the above mass law. The coincidence or critical frequency is shown by:

$$f_c = A/t$$

where: A is a constant for a material
t is the thickness of the material (mm)

There are other factors in wall, roof, ceiling & floor design such as the mass-air-mass resonance, which also affect transmission loss at different frequencies.

Generally, relying only on the mass law to achieve a specific TL results in a thick wall, ceiling or floor construction, which reduces usable floor area and ceiling height in an apartment dwelling. Attempts to avoid those coincidence dips noted above appear only to increase transmission loss slightly, if at all. Generally only very expensive and labour *intensive solutions give an acceptable transmission loss. Building regulations are becoming* more strict while more apartment blocks are being constructed, with cost being a pre-eminent factor.

The Sound Transmission Loss of a dividing structure separating two spaces varies with frequency. If the structure has a degree of stiffness, incident acoustic energy causes the structure to vibrate which re-radiates the acoustic energy on the other side of the structure. Low frequency re-radiation is mainly controlled by the structure stiffness. At about an octave above the lowest resonance frequency of the barrier, the mass of the structure takes over control of the re-radiation and dominates the sound reduction performance, and the mass law (above) indicates that doubling the mass of the structure increases the structure's noise attenuation performance by approximately 6dB.

High frequency incident acoustic energy causes ripple-, or bending-waves of the surfaces of the structure. Unlike compression waves, the velocity of bending waves increases with frequency. Every 'stiff panel construction' has a critical or coincidence frequency which considerably reduces the Sound Transmission Loss of structural panel construction.

A common coincidence frequency occurs between 1000 & 4000 Hz and is caused by the bending wave speed in the material equaling the speed of sound in the medium surrounding the panel (in this case air). In this frequency range the waves coincide and reinforce each other in phase, greatly reducing the noise reduction performance of the panel at approximately the critical frequency.

The present invention seeks to ameliorate one or more of the abovementioned disadvantages of known methods of increasing TL such as higher cost, mass & reduced available space.

Summary of the invention

According to one aspect of the present invention there is provided an acoustic laminate suitable for use in wall, floor and ceiling assemblies and other dividing structure assemblies, the laminate including: a viscoelastic acoustic barrier being in the form of discrete, spaced apart sections or a continuous layer; and a construction panel, the barrier affixed to one or more panel faces of the construction panel.

Preferably the construction panel is plasterboard, medium-density fibreboard, plywood, fibre-cement sheeting or timber.

Throughout this specification, "construction panel" is to be taken to include those panels constructed from fibreglass, composites such as carbon fibre, sheets used in domestic construction of walls, glass-reinforced plastics, plasterboard, medium-density fibreboard, plywood, fibre-cement sheeting or timber. Excluded from the definition are steel sheets, aluminium, C-beams, I-beams, structural supports and the like. Furthermore, "panel" is to be taken to include a panel having contours or curvature such as for example, sinusoidal, or of course completely flat.

Preferably the construction panel is affixed to the viscoelastic acoustic barrier layer by adhesive.

Preferably the viscoelastic acoustic barrier is poured onto the construction panel and cures on the panel, bonding to the panel during curing.

Preferably the viscoelastic acoustic barrier layer is affixed to the construction panel in strips along an axis parallel to respective panel faces.

Preferably a matrix of viscoelastic pads are affixed to the construction panel across respective panel faces.

Preferably a second layer of construction panel is affixed to an outer face of the viscoelastic barrier or strips or pads in order to provide a three-layer laminate, for captive-, or constrained-layer damping-type effect.

Preferably the viscoelastic acoustic barrier layer has a density within a range of 1000 kg/m^3 to $3000kg/m^3$.

Preferably the viscoelastic acoustic barrier layer has a surface density of approximately 2.5 kg/m^2.

Preferably the viscoelastic acoustic barrier layer has a thickness below 6mm.

Preferably the viscoelastic acoustic barrier layer has a thickness of 1.7mm.

Preferably the viscoelastic acoustic barrier layer has a density is $1470kg/m^3$.

Preferably the viscoelastic acoustic barrier layer is a polymeric elastomer impregnated with material which in preferred forms is a particulate material.

Preferably the filler material is calcium carbonate.

Preferably the viscoelastic acoustic barrier layer is faced on one side with a nonwoven polyester of thickness approximately 0.05mm.

Preferably the viscoelastic acoustic barrier layer is faced on the other side of the viscoelastic barrier or strips or pads by an aluminium film reinforced with polyester as a water barrier.

Preferably the viscoelastic acoustic barrier layer has a Young's Modulus of less than 344kPa.

Preferably the acoustic laminate is incorporated into a wall structure utilising staggered *studs and a cavity filled with polyester batts or other sound absorptive material.*

Preferably the viscoelastic acoustic barrier layer is in the form of a composition which includes water, gelatine, glycerine and a filler material.

Preferably the composition includes:

5 – 40 wt% water
5 – 30 wt% gelatine
5 – 40 wt% glycerine; and
20 – 60 wt% filler material.

Preferably the composition includes 1 to 15 wt% of a group II metal chloride such as for example calcium chloride or magnesium chloride.

Preferably the composition includes 2 to 10 wt% magnesium chloride.

Preferably the composition further includes 0.5 to 7 wt% starch or gluten.

Preferably the starch is provided from the addition of cornflour to the composition.

Preferably the filler material is a non-reactive material with a high density.

Preferably the density is greater than 1 g/cm^3.

Preferably the density of the filler material is approximately 2.0 to 3.0 g/cm^3.

Preferably the filler material is chosen from any non-reactive material with a high density such as for example barium sulphate or KAOLIN.

Preferably the composition includes:

10 – 25 wt% water
5 – 20 wt% gelatine
10 – 25 wt% glycerine;
40 – 60 wt% filler material;
1 – 10 wt% magnesium chloride; and
0.5 – 3 wt% starch;

Preferably the composition further includes constituents such as for example ethylene and/or propylene glycols; polyvinyl alcohols; deodorisers; anti-oxidants and/or fungicides.

Preferably a wall construction is provided, incorporating additional layers of construction panel are provided, affixed to staggered studs.

Preferably the a wall construction is provided, which includes absorbent material in the form of polyester batts.

Description of Preferred Embodiment

In order to enable a clearer understanding of the invention, drawings illustrating example embodiments are attached, and in those drawings:

Figure 1 is a schematic representation of a reference wall (typical of current construction method) used in testing to give a benchmark for measured results;

Figure 2 is a schematic representation of a wall constructed in part using components of a preferred embodiment of the present invention;

Figure 3 is a graph showing results of benchmark transmission loss testing of the reference wall shown in Figure 1 (an STC60 curve is superposed on the test results);

Figure 4 is a graph showing results of transmission loss testing of the wall shown in *Figure 2 (an STC63 curve is superposed on the test results); and*

Figure 5 is a graph showing graphs in Figures 3 and 4 superposed on similar axes;

Figure 6 is a graph showing expected coincidence effects of prior art stiff panels;

Figure 7 shows Transmission Loss (TL) test results of a reference wall of the prior art displaying coincidence dip effects;

Figure 8 shows TL test results of a wall treated with preferred embodiments of the present invention, showing the much reduced coincidence dips, if detectable at all;

Figure 9 shows TL test results of a wall treated with another preferred embodiment of the present invention – ie spaced viscoelastic strips (an STC curve is superposed on the results, and corrected data is also shown in broken line);

Figure 10 shows the composition of the reference wall tested in Figure 9;

Figure 11 shows TL test results of a wall treated with yet another preferred embodiment of the present invention – ie viscoelastic pads spaced on a matrix (an STC curve is superposed on the results, and corrected data is also shown in broken line);

Figure 12 shows the composition of the reference wall tested in Figure 11.

Referring to Figure 1 there is shown a reference wall generally indicated at 1. The reference wall is a composite wall consisting of two layers of 13mm thick fire rated plasterboard directly secured to 64mm, 0.75mm steel studs on one side. The wall is wholly repeated in mirror image about a centreline extending between the studs, with a 20mm gap separating the studs. An infill cavity insulation of 50mm glasswool 11kg/m^3 is located between one set of the steel studs.

A *composite wall assembly utilising a preferred embodiment of the present* invention is shown at Figure 2 item 20. The composite wall assembly includes a laminate assembly 12 including a layer of 13mm high density plasterboard 14, adhered to one face of a centre lamina of 2.5kg loaded polymeric elastomer shown at 16, which is itself on its other side adhered to a 13mm standard density plasterboard 18. The laminate assembly 12 is affixed to 64mm, 0.6mm thick steel studs 22. A cavity 24 is provided, filled on one side with 50mm thick 48kg/m^3 polyester insulation batts 26. On the other side of the cavity 24, studs 23 are provided, the studs 23 being staggered from studs 22. Affixed to the studs 23 is a laminate assembly 13, a mirror image of the laminate assembly 12.

<u>Experimental data utilising preferred embodiments of the present invention</u>

A reference wall and a composite wall, each in accordance with the above descriptions and Figures were constructed, and their sound transmission performance was tested. A +1.OdB correction was applied during testing to the reference wall to align its glasswool performance with that of the composite wall. The composite wall utilised 48kg/m^3 and the reference wall used 1 lkg/m^3 glasswool to infill one side of the cavity.

Description	**1/3 Octave Band Centre Frequency**								
	100	**125**	**160**	**200**	**250**	**315**	**400**	**500**	**630**
Composite Wall	45	45	48	50	53	56	57	59	61
Reference Wall	37	42	44	47	51	51	55	58	61
Improvement	*8*	*3*	*4*	*3*	*2*	*5*	*2*	*1*	*0*

Table 1: Comparison Results of the Testing Conducted.

Description	**1/3 Octave Band Centre Frequency**								
	800	**1000**	**1250**	**1600**	**2000**	**2500**	**3150**	**4000**	**5000**
Composite Wall	64	66	67	67	68	70	73	77	78
Reference Wall	62	64	66	68	64	61	64	64	64
Improvement	*2*	*2*	*1*	*-1*	*3*	*9*	*9*	*13*	*14*

Figures 3, 4 and 5 show the tabulated results graphically.

The table above and the graphs show the improvement in acoustic performance that occurs in the nominated frequency regions due to the addition of a lamina of loaded polymeric elastomer 16, surface density of 2.5kg/m^2, between a sheet of 13mm high-density plasterboard 14 and a sheet of 13mm normal density plasterboard 18. Normal experience teaches that a very small improvement of performance in a so-called coincidence dip frequency region (2500Hz in this case) can occur where plasterboards of differing densities are adhered together. This improvement is normally only of the order of 2 to 3dB. However, the performance gain in this experiment for the composite wall assembly 20 is 9dB, with significant gains in performance occurring above this frequency.

The combined graph (Figure 5) and table shows an improvement in the frequency regions of 100Hz to 400Hz and from 2000Hz to 5000Hz.

When the concept of Acoustic Performance Index is applied to the composite wall assembly 20 (Figure 2) , the score is extremely high. Acoustic Performance Index takes into account the cost of the wall compared to its acoustic performance and to the thickness of the wall and the floor space cost. Thickness is a very important consideration as floor space in a typical apartment is AU$6000 per square metre. The composite wall assembly 20 is only 206mm wide and has an acoustic performance that can only be matched by expensive wall systems which are 280mm wide or more. The composite wall system has a high Acoustic Performance Index of R_w greater than or equal to 55.

The combination of the construction panel and viscoelastic barrier provide an unexpected synergy. It would be expected that adding a very thin layer of dense material would only provide a small benefit according to the mass law. For example, at 1250 Hz, increasing the mass by 6kg/m^2, (as we have shown above in the testing) we are expected to *produce a gain in transmission loss of 2dB (see Also Figure 6). However, in the testing* above, at that frequency, we see TL gain of 21dB.

Furthermore, the expected coincidence dip does not eventuate. We would have expected that the change in stiffness would have given us a change in transmission loss of 1.6dB at 2500Hz. However, we demonstrated at that frequency, a change of 18dB.

By affixing viscoelastic material to construction panel in the form of plasterboard the panel resonance at low frequencies was reduced and stiff panel 'Coincidence effects' were greatly reduced at higher frequencies, especially the frequencies at which the ear is most sensitive.

Other embodiments have been tested: In one embodiment, strips of viscoelastic material covering 25 - 50% of the panel surface were affixed to the stiff construction panel. The strips were paced by air gaps which formed small voids of less than 4mm thickness. The resulting damping is apparently as effective as having a full sheet of viscoelastic barrier material on the construction panel, in the sense that shear strains within the viscous-elastic material are still induced which greatly reduces or eliminates the stiff panel construction 'Coincidence effect' in the band width 1000 - 4000 Hz, which is the ear's most sensitive region.

It is believed that the small spaced air gaps (2-4mm in thickness) between the construction panels, spaced also between viscoelastic strips or pads appear to act the same way as the actual viscoelastic material. That is, they do not allow the bending wave generated in the panel to reach the speed of sound in the medium surrounding the panel and thus avoid coincidence dips and phase reinforcement.

It should be noted that shear strains in the viscoelastic treatment actually transform bending waves into heat energy which is noiseless.

Advantageously, preferred embodiments such as for example that shown at Figs 10 and *12 of this invention function via the following mechanism:*

> Most rigid materials will be sympathetic to vibration at one or more frequencies, and damping materials are an efficient and effective means to control vibration and structure-borne radiated noise.

> 'Damping' is the energy dissipation properties of a material or system under cyclic stress, and damping vibration can significantly reduce the creation of secondary noise problems.

With the above two paragraphs in mind, the specially formulated non slip viscoelastic strips or pad matrix situated on the construction panel are in contact with the construction panel effectively increasing the vibrations' decay rate. Decay rate is the speed in dB/second at which the vibration reduces after panel excitation has ceased - the higher the decay rate, the better the acoustic performance.

By applying viscoelastic barrier material in strips and pads to construction board in the form of plasterboard the panel resonance at low frequencies was reduced and 'Coincidence effects' were also substantially eliminated.

Although not shown in the drawings, a method of adhering the construction panel and viscoelastic barrier together has shown excellent adhering properties, and that is to utilise a pouring head which pours a hot or warm viscoelastic composition directly onto the construction board. The composition cools and then grips the face of the board. This may be used to make sandwiches of the compound, ie a second layer of construction board on to an upper surface of the cooling or curing composition.

Further experiments have been conducted on other preferred embodiments:

In one embodiment, a wall was constructed as shown in Figure 10, starting on the outside: 13mm standard plasterboard panel 114; viscoelastic barrier 116 in strips 50mm wide, spaced at 50mm intervals along the panel 114; 13mm standard plasterboard panel 118; 64mm staggered studs 122 in 90mm track; 20kg/m^3 polyester batt 126, 13mm standard plasterboard panel 115; viscoelastic barrier in strips 50mm wide 117, spaced at 50mm intervals; 13mm standard plasterboard panel 119. This wall underwent TL testing and the results are shown at Figure 9. Only a slight coincidence dip occurs at 1000 – 4000Hz. Overall, the STC and corrected transmission loss data are unexpectedly high for this type of construction.

Similarly, a wall constructed as shown in Figure 12 has a plurality of 50mm viscoelastic strips 216 spaced with a 150mm gap between each. The TL results appear at Figure 11 and they seem very similar to those shown in Figure 10, the only difference being the spacing between the viscoelastic strips. These results show the mechanism of the trapped air apparently working as a viscoelastic medium which reduces the buildup of transverse waves in the panel, without the mass or expense of an actual viscoelastic medium. Again, the STC and corrected transmission loss data are unexpectedly high for this type of construction.

Some wall constructions do not include any absorptive batt material, and the results appear to be better than similar walls without absorptive batts.

A feature of a preferred embodiment of the present invention will become better understood from the following example of a preferred but non-limiting embodiment thereof.

Example

100 g of water together with 100 g of glycerine and 10 g of starch was mixed and then heated to a temperature of 85 °C. 80 g of gelatine and 20 g of magnesium chloride was then dissolved into the mixture and a gel was formed. 310 g of barium sulphate was then added to the gel providing a composition with good flexibility, elasticity, tensile strength, and density with good film forming properties. The composition had the following composition by weight:

16% water;
16% glycerine;
1.5% starch;
13% gelatine;
3.5% magnesium chloride; and
50% barium sulphate.

The composition was then extruded into a flat sheet and bonded onto an aluminium film and then brought down to room temperature whereby the composition cured to form a sheet of composite material of 4mm in thickness that showed excellent sound dampening properties.

Finally, it is to be understood that various alterations, modifications and/or additions may be incorporated into the various constructions and arrangements of parts without departing from the spirit or ambit of the invention.

CLAIMS:

1. An acoustic laminate suitable for use in wall, floor and ceiling assemblies and other dividing structure assemblies, the laminate including: a viscoelastic acoustic barrier being in the form of discrete, spaced apart sections or a continuous layer; and a construction panel, the barrier affixed to one or more panel faces of the construction panel.

2. An acoustic laminate according to claim 1, wherein the construction panel is plasterboard, medium-density fibreboard, plywood, fibre-cement sheeting or timber.

3. An acoustic laminate according to claim 1 or 2, wherein the construction panel is affixed to the viscoelastic acoustic barrier layer by adhesive.

4. An acoustic laminate according to any previous claim wherein the viscoelastic acoustic barrier is poured onto the construction panel and cures on the panel, bonding to the panel during curing, providing increased bonding strength after cooling.

5. An acoustic laminate according to any previous claim wherein the viscoelastic acoustic barrier layer is affixed to the construction panel in strips along an axis parallel to respective panel faces.

6. An acoustic laminate according to any previous claim wherein a matrix of viscoelastic pads are affixed to the construction panel across respective panel faces.

7. An acoustic laminate according to any previous claim wherein a second layer of construction panel is affixed to an outer face of the viscoelastic barrier or strips or pads in order to provide a three-layer laminate, for captive-, or constrained-layer damping-type effect.

8. An acoustic laminate according to any previous claim wherein the viscoelastic acoustic barrier layer has a density within a range of 1000 kg/m^3 to 3000kg/m^3.

9. An acoustic laminate according to any previous claim wherein the acoustic laminate inhibits transmission at the frequencies typically forming a coincidence dip in construction panels, being approximately 1000 – 4000Hz.

10. An acoustic laminate according to any previous claim wherein the viscoelastic acoustic barrier layer has a thickness below 6mm.

11. An acoustic laminate according to any previous claim wherein the viscoelastic acoustic barrier layer has a thickness of 1.7mm.

12. *An acoustic laminate according to any previous claim wherein the viscoelastic* acoustic barrier layer has a density is 1470kg/m^3.

13. An acoustic laminate according to any previous claim wherein the viscoelastic acoustic barrier layer is a polymeric elastomer impregnated with material which in preferred forms is a particulate material.

14. An acoustic laminate according to claim 13 wherein the filler material is calcium carbonate.

15. An acoustic laminate according to any previous claim wherein the viscoelastic acoustic barrier layer has a Young's Modulus of less than 344kPa.

16. An acoustic laminate according to any previous claim wherein the acoustic laminate is incorporated into a sandwich of: construction board/viscoelastic barrier or strips or pads/construction board.

17. An acoustic laminate according to any previous claim wherein the acoustic laminate is incorporated into a wall construction utilising studs and a cavity filled with polyester batts or other sound absorptive material.

18. An acoustic laminate according to any previous claim wherein the viscoelastic acoustic barrier layer is in the form of a composition which includes water, gelatine, glycerine and a filler material.

19. An acoustic laminate according to claim 19 wherein the composition includes:

    5 – 40 wt% water

    5 – 30 wt% gelatine

    5 – 40 wt% glycerine; and

    20 – 60 wt% filler material.

20. An acoustic laminate according to claim 19 or 20 wherein the composition includes 1 to 15 wt% of a group II metal chloride such as for example calcium chloride or magnesium chloride.

21. An acoustic laminate according to any one of claims 19 - 21 wherein the composition includes 2 to 10 wt% magnesium chloride.

22. An acoustic laminate according to any one of claims 19 - 22 wherein the composition further includes 0.5 to 7 wt% starch or gluten.

23. An acoustic laminate according to any one of claims 19 - 23 wherein the starch is provided from the addition of cornflour to the composition.

24. An acoustic laminate according to any one of claims 19 - 24 wherein the filler material is a non-reactive material with a high density.

25. An acoustic laminate according to any one of claims 19 - 25 wherein the density is

greater than 1 g/cm^3.

26. An acoustic laminate according to claim 25 or 26 wherein the density of the filler material is approximately 2.0 to 3.0 g/cm^3.

27. An acoustic laminate according to any one of claims 19 – 27 wherein the filler material is chosen from any non-reactive material with a high density such as for example barium sulphate or KAOLIN.

28. An acoustic laminate according to any one of claims 19 – 28 wherein the composition includes:

    10 – 25 wt% water
    5 – 20 wt% gelatine
    10 – 25 wt% glycerine;
    40 – 60 wt% filler material;
    1 – 10 wt% magnesium chloride; and
    0.5 – 3 wt% starch;

29. An acoustic laminate according to any one of claims 19 – 29 wherein the composition further includes constituents such as for example ethylene and/or propylene glycols; polyvinyl alcohols; deodorisers; anti-oxidants and/or fungicides.

30. A wall construction including an acoustic laminate according to any previous claim and including layers of construction panel affixed to staggered studs.

31. A wall construction including an acoustic laminate according to any previous claim and including absorbent material in the form of polyester batts.

32. An acoustic laminate substantially as hereinbefore described with reference to the attached drawings.

33. A wall construction substantially as hereinbefore described with reference to the attached drawings.

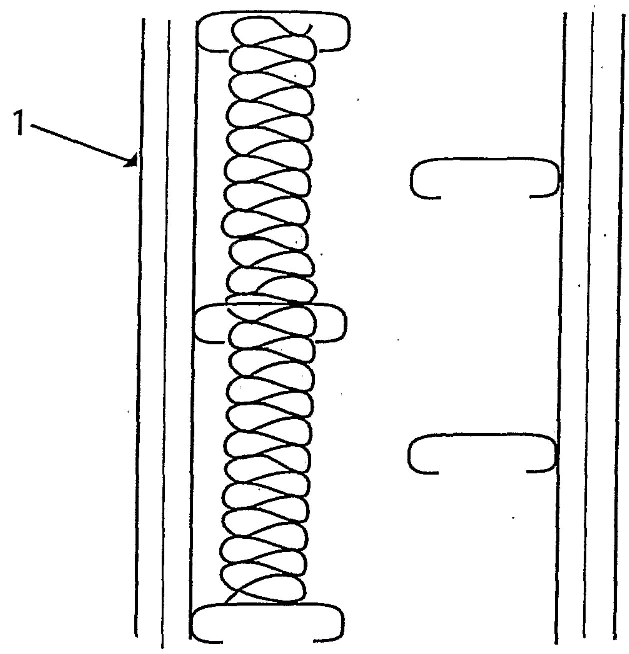

Fig. 1

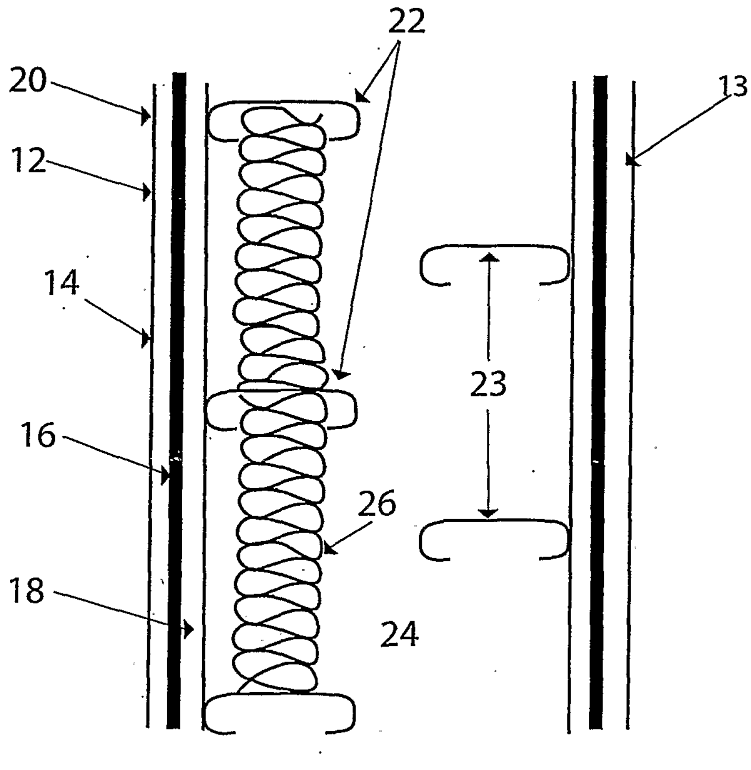

Fig. 2

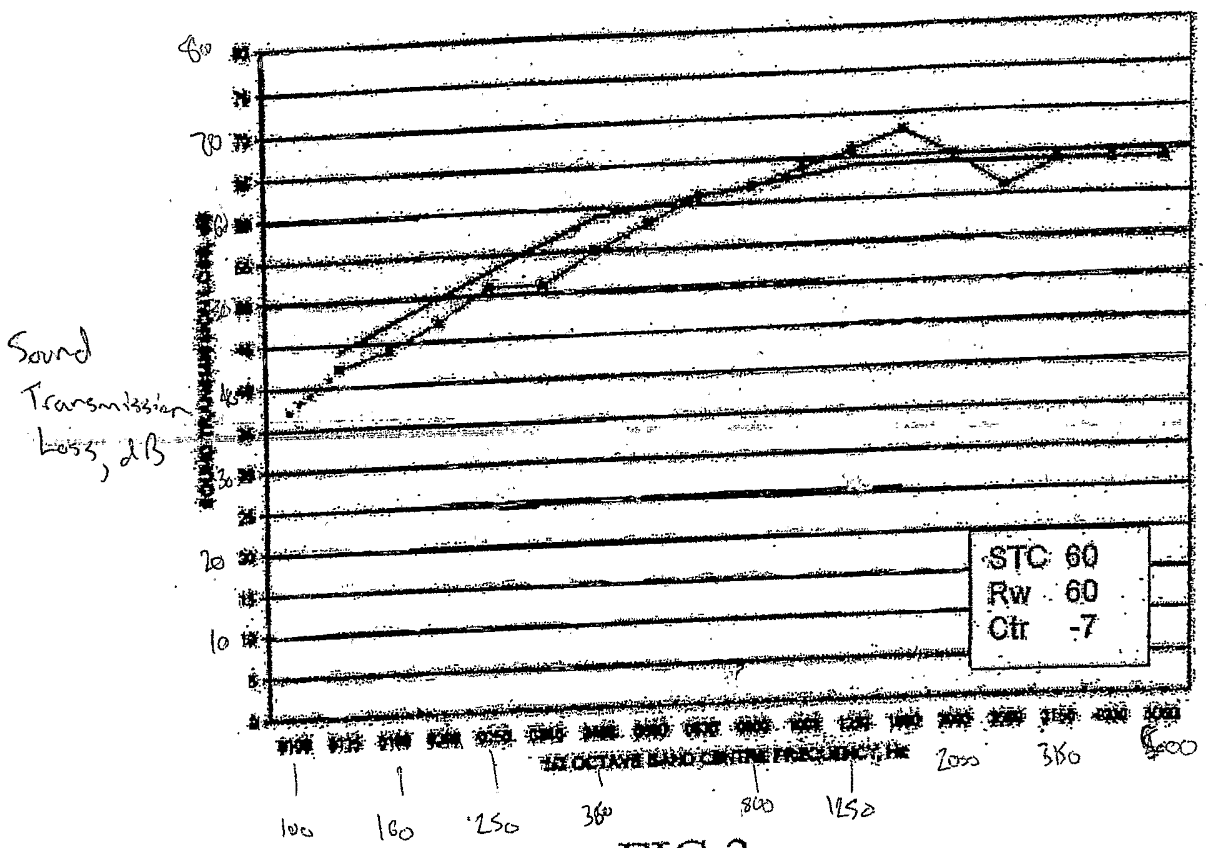
Sound Transmission Loss, dB
STC 60
Rw 60
Ctr -7
1/3 OCTAVE BAND CENTRE FREQUENCY, Hz

FIG 3

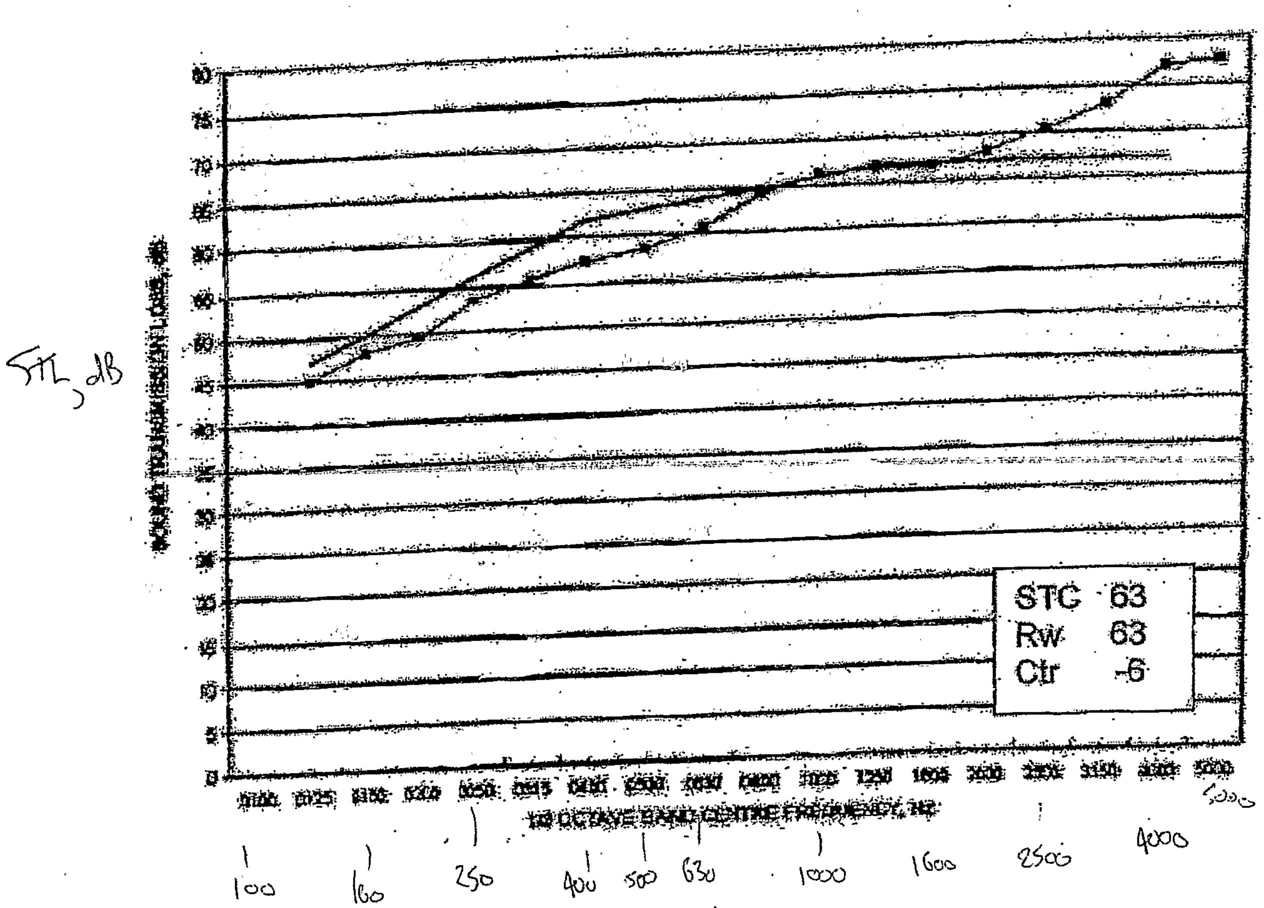
STL, dB
STC 63
Rw 63
Ctr -6
100
160
250
400
500
630
1000
1600
2500
4000
5000

FIG 4

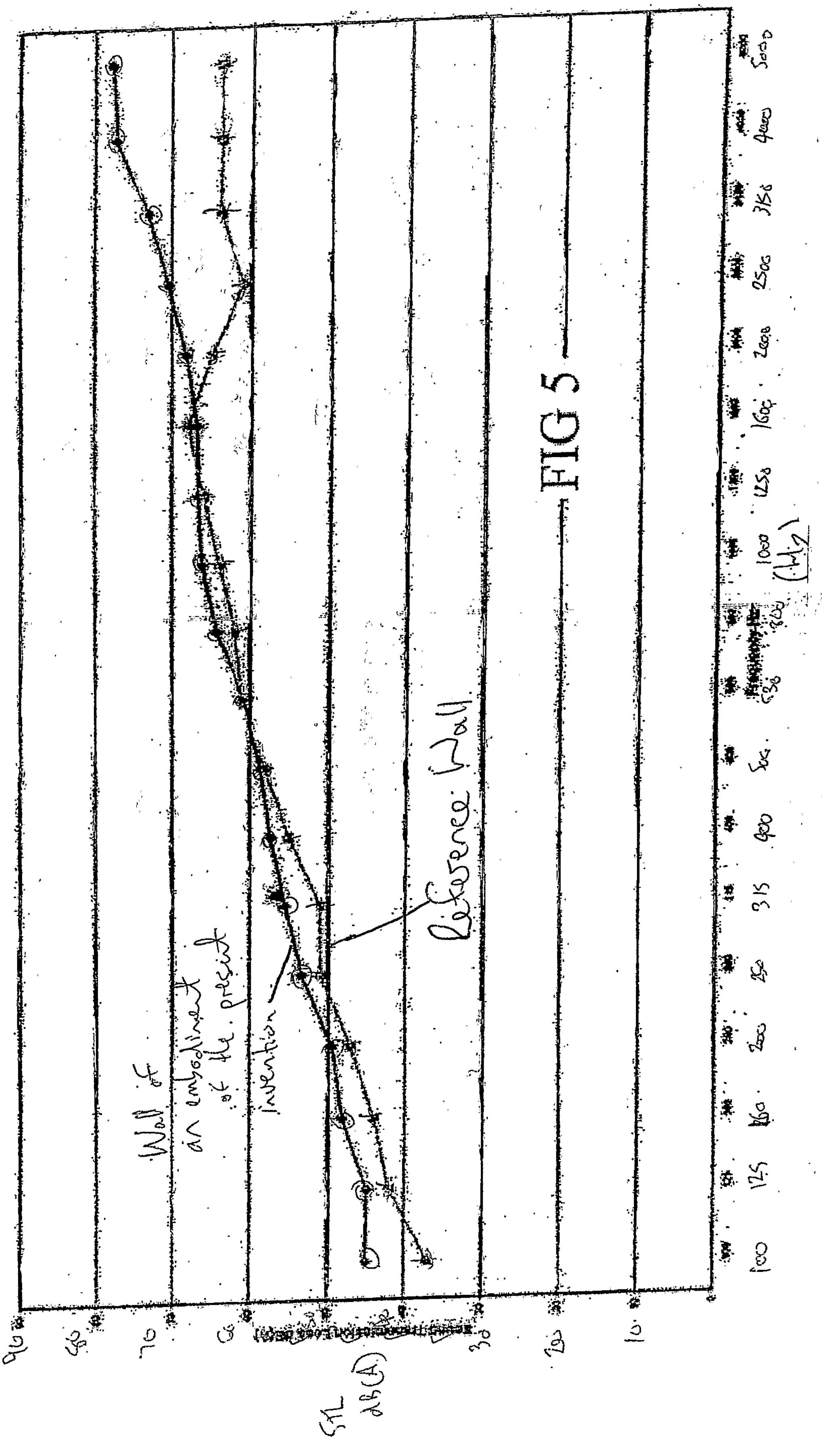
Wall of
an embodiment
of the present
invention
Reference Wall
STL
dB(A)
(Hz)
100
125
160
200
250
315
400
500
630
800
1000
1250
1600
2000
2500
3150
4000
5000
10
20
30
60
70
80
90

FIG 5

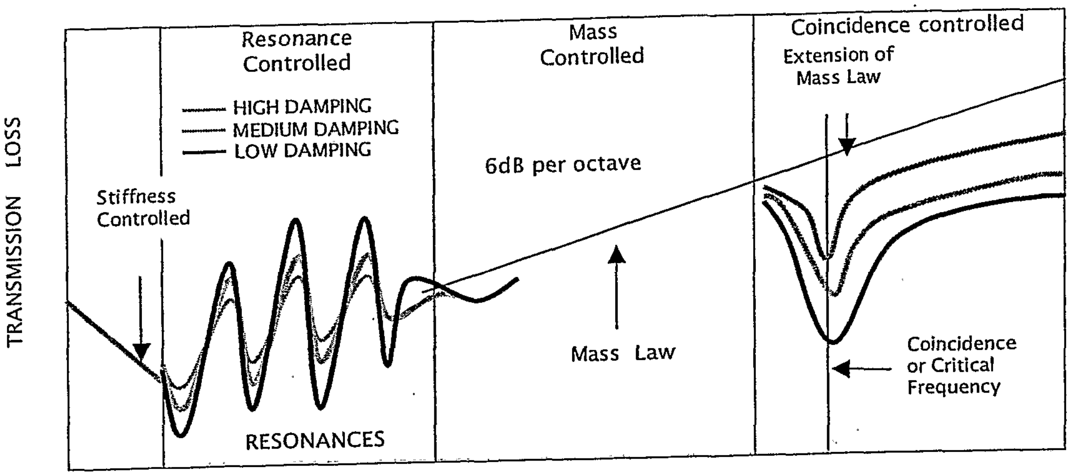
TRANSMISSION LOSS
Resonance Controlled
HIGH DAMPING
MEDIUM DAMPING
LOW DAMPING
Mass Controlled
Coincidence controlled
Extension of Mass Law
6dB per octave
Stiffness Controlled
Mass Law
Coincidence or Critical Frequency
RESONANCES

FIG. 6

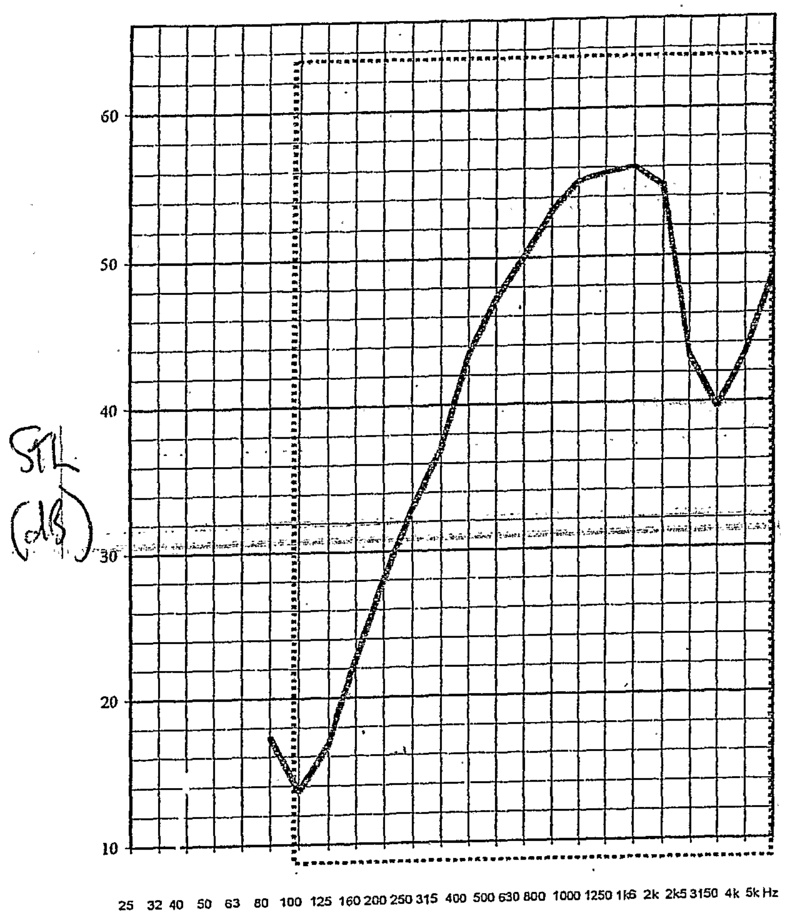
STL (dB)
60
50
40
30
20
10
25 32 40 50 63 80 100 125 160 200 250 315 400 500 630 800 1000 1250 1k6 2k 2k5 3150 4k 5k Hz

FIG. 7

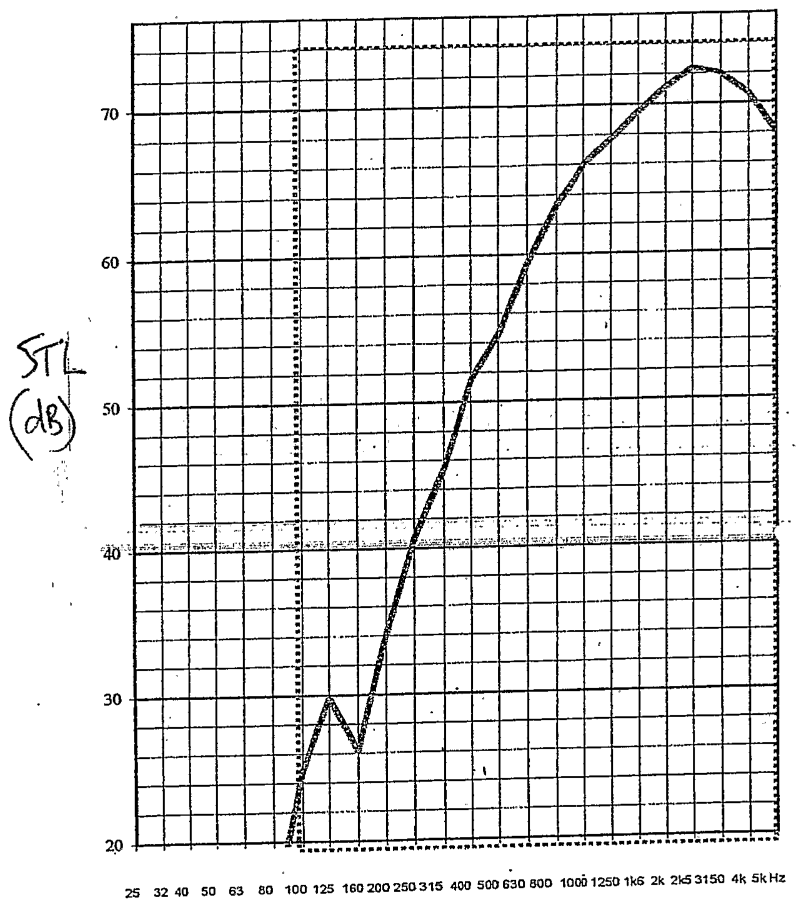
STL (dB)
70
60
50
40
30
20
25 32 40 50 63 80 100 125 160 200 250 315 400 500 630 800 1000 1250 1k6 2k 2k5 3150 4k 5k Hz

FIG. 8

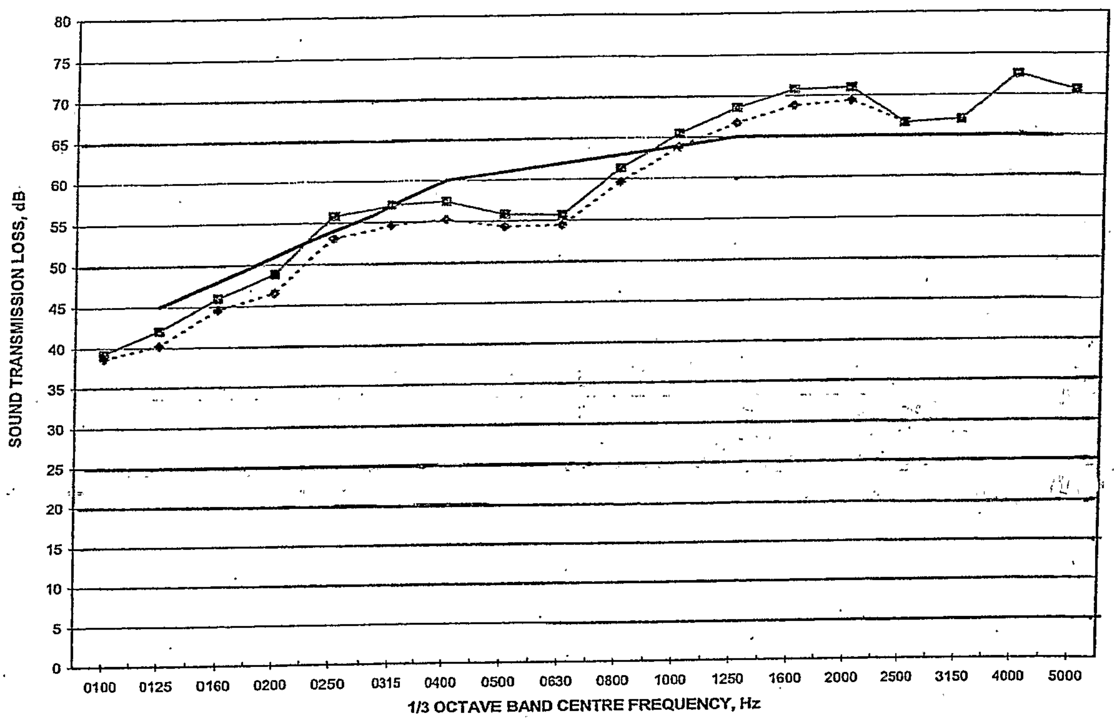
SOUND TRANSMISSION LOSS, dB
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
0100 0125 0160 0200 0250 0315 0400 0500 0630 0800 1000 1250 1600 2000 2500 3150 4000 5000
1/3 OCTAVE BAND CENTRE FREQUENCY, Hz

FIG. 9

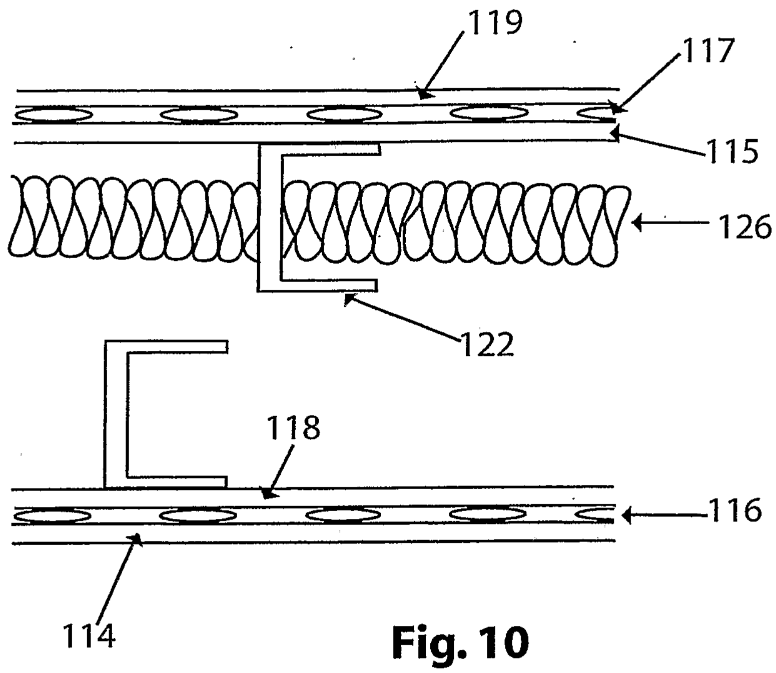

Fig. 10

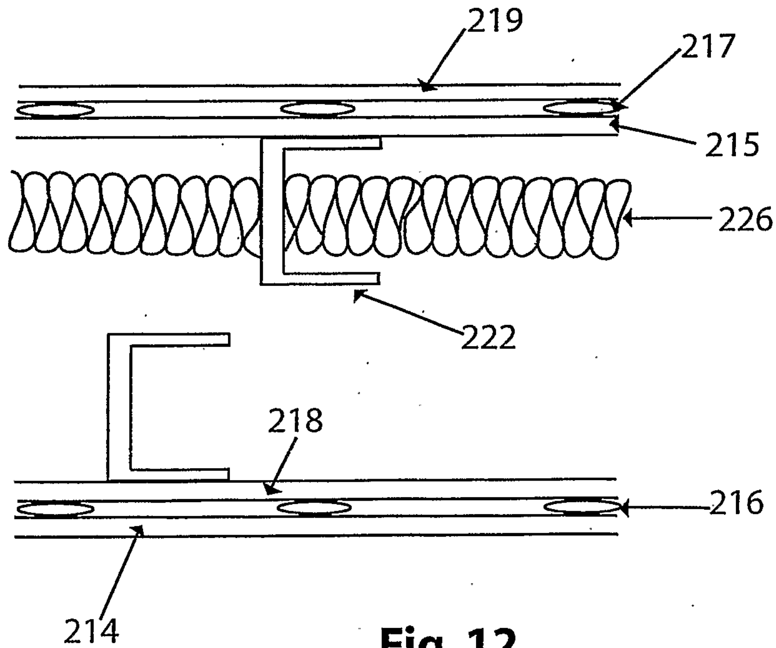

Fig. 12

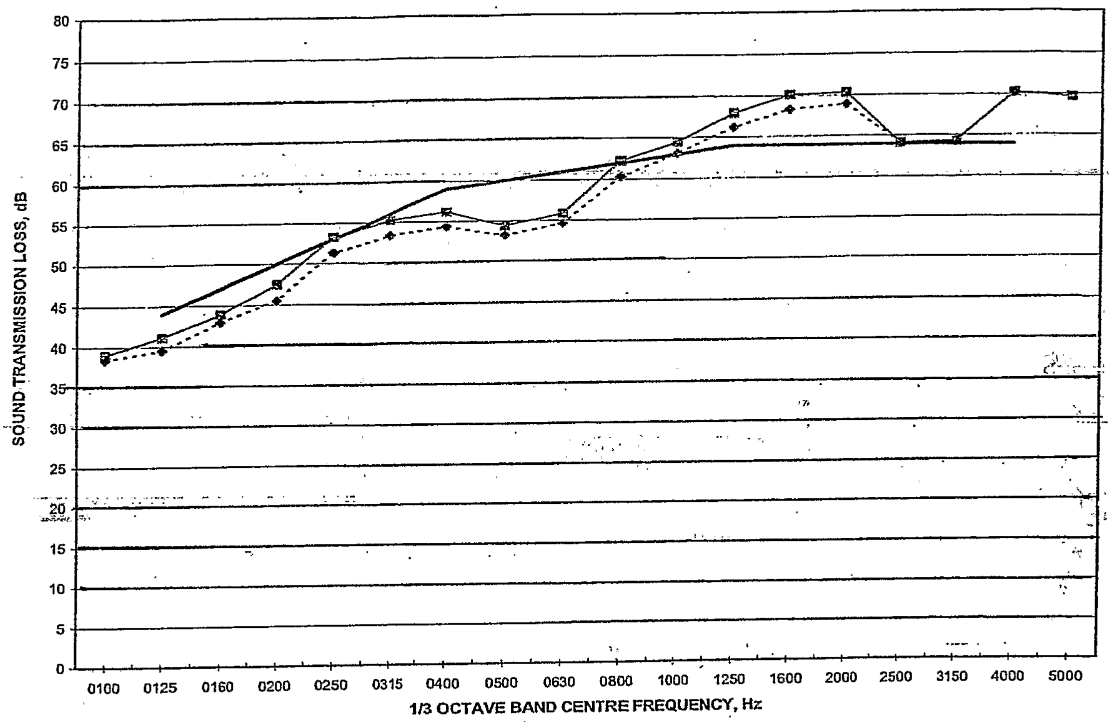
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
SOUND TRANSMISSION LOSS, dB
0100 0125 0160 0200 0250 0315 0400 0500 0630 0800 1000 1250 1600 2000 2500 3150 4000 5000
1/3 OCTAVE BAND CENTRE FREQUENCY, Hz

FIG. 11

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU2005/000520

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl. [7]: E04B 1/86

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
AU: E04B 1/86

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
Derwent file dwpi: E04B, E04C, E04F, B32B, and keywords, acoustic, sound, viscoelastic

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	FR 2811350 A (KNAUF SNC) 11 January 2002. All document.	1-7, 16, 17 8-15
X Y	FR 2727450 A (DISTRIBUTION STAFF MECANIQUE DSM SOCIETE A RESPONSABILITE LIMITEE) 31 May 1996. All document.	1-8 9-17
X Y	EP 864712 B (Per AKUSTIK AG) 14 November 2001. All document.	1-8 9-17
X Y	EP 461328 A (TINE HOLDING S.A.) 18 December 1991. All document.	1-8 9-17
X	JP 2001-142466 A (TOKAI RUBBER IND LTD) 25 May 2001. Derwent English language abstract, Accession no. 2001-585561, Class P86.	1
X	JP 2002-070200 A (TOYO KENSETSU KK) 8 March 2002. Derwent English language abstract, Accession no. 2002-324383, Class Q43.	1-3, 7, 16
Y	EP 278393 A (C.S.P. CENTRO STUDI E PROTOTIPI S.R.L.) 17 August 1988. See reference to Calcium Carbonate.	1-14
Y	WO 2001/096695 A (SAINT-GOBIAN PERFORMANCE PLASTICS CORP.) 20 December 2001. See page 5, lines 10-30.	1

☐ Further documents are listed in the continuation of Box C ☒ See patent family annex

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

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"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
16 May 2005	19 MAY 2005
Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaustralia.gov.au Facsimile No. (02) 6285 3929	Authorized officer **DAVID LEE** Telephone No : (02) 6283 2107

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/AU2005/000520

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member			
FR	2811350				
FR	2727450				
EP	0864712				
EP	0461328	PT	97957		
JP	2001142466				
JP	2002070200				
EP	0278393	JP	63239049	US	5266143
WO	0196695	AU	70322/01		

Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.

END OF ANNEX