(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
26 October 2012 (26.10.2012)

WIPO | PCT

(10) International Publication Number
WO 2012/143305 A1

(51) International Patent Classification:
*B62D 29/00* (2006.01)

(21) International Application Number:
PCT/EP2012/056848

(22) International Filing Date:
13 April 2012 (13.04.2012)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
1106813.7 21 April 2011 (21.04.2011) GB

(71) Applicant *(for all designated States except US)*: **ZEPHYROS INC** [US/US]; 160 McLean Drive, Romeo, MI 48065 (US).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: **COULON, Jean-Michel** [FR/FR]; 1 rue Lindberg, ZA Activeum, F-67129 Molsheim cedex (FR). **KAGEMANN, Jörn** [DE/FR]; 1 rue Lindberg, ZA Activeum, F-67129 Molsheim cedex (FR). **FARHNER, Philippe** [FR/FR]; 1 rue Lindberg, ZA Activeum, F-67129 Molsheim cedex (FR).

(74) Agent: **BAWDEN, Peter, Charles**; Bawden & Associates, 4 The Gatehouse, 2 High Street, Harpenden, Hertfordshire AL5 2TH (GB).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

**Published**:

— *with international search report (Art. 21(3))*

WO 2012/143305 A1

(54) Title: IMPROVEMENTS IN OR RELATING TO BAFFLES

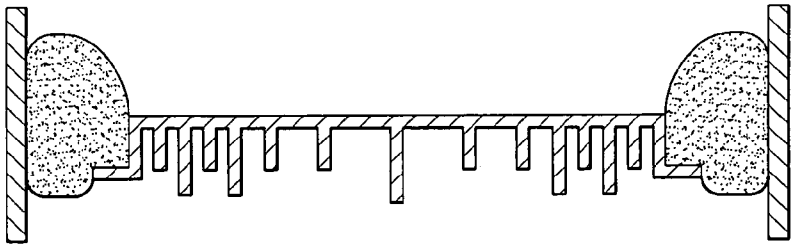

Fig - 3

(57) Abstract: Acoustic baffles comprising a central plate (1) provided with a ribbon of foamable material (4) around its perimeter are provided. The central plate is provided with ribs which enable a thinner plate to be used for comparable acoustic insulation which allows a faster moulding cycle.

# IMPROVEMENTS IN OR RELATING TO BAFFLES

The present invention relates to baffles and particularly baffles that are employed in cavities in automobile structures to provide seals and/or sound insulation in particular improved sound insulation.

It is well known to provide baffles within cavities in automobile structures and various forms of baffles are known. Initially metal components were located within the cavities which are typically within tubular metal structures. Previously as a general guideline the sound barrier properties that are required should be similar to those of the vehicle metal panels which are typically from 0.7 to 0.8 millimetre thick steel. It was then proposed to provide foamed inserts within the cavity, typically made of foamed polymeric material. Such inserts posed the problem of how best to locate the insert within the cavity and furthermore the foamed polymeric material can be very expensive and substantial quantities were required in order to provide adequate sealing and/or sound insulation in the various positions in the vehicle where it may be required.

A vehicle frame typically consists of a frame comprising a main frame comprising rails and cross members and subframes which support the working components of the vehicle. The frame also supports pillars such as the A, B and C pillars which are the vertical support components of the vehicle. These pillars in turn support roof structures, doors, windows etc. Sound insulation and/or seals may be required in many of these locations and accordingly a large number of seals or baffles may be required at different locations within a single vehicle. The size and shape of each baffle will be determined by the size and shape of the cavity in which the sealing or sound alternation are required.

In the late 1990's baffles were developed and sold comprising a plate of material surrounded by a ribbon of foamable material. The plate may be integrally formed with a fastener such as a clip which would enable the baffle to be located at the desired position within the vehicle cavity. The foamable material could be formulated so that it would foam at temperatures experienced during automobile manufacture such as the temperatures experienced in the anticorrosion coating (sometimes known as e-coat) process such as the coating bake ovens or the paint bake ovens. Such baffles are described in Japanese Patent Publications Kokai 10-71628 and 2001-30252. The plate may be of metal or moulded plastic, whatever the material the plate needed to be of a thickness that would provide the desired sound barrier properties.

The commercial baffles of this type consisted of a plastic plate carrying a ribbon of foamable material around its extremity. The plastic plate could be formed by injection moulding and the means of attachment within the vehicle cavity (such as a clip) could be integrally moulded with the plate. The ribbon of foamable material could be provided on the perimeter of the plate by overmoulding of the foamable material providing the overmoulding took place at a temperature below that at which the foaming would take place.

These baffles could be mounted within the vehicle cavity whilst leaving a gap between the exterior of the ribbon of foamable material and the internal surface of the cavity of the vehicle. The presence of the gap enabled the internal surface of the metal defined cavity to be coated with the anticorrosion material in the immersion of the vehicle structure (body in white) in the bath of anticorrosion material for deposition of the anticorrosion coating on the metal. Subsequently the coated structure would be heated in an oven to bake the anticorrosion coating and the foamable material was formulated to foam at that temperature to bridge the gap previously formed between the exterior of the foamable material and the interior of the vehicle and to some extent cover the plate in this way providing the desired sound insulation and sealing.

The plate of the baffle was usually formed from a thermoplastic material by injection moulding and strong materials such as polyamide and rigid polyolefins were preferred. Typical examples include fibre reinforced nylon and polypropylene. Glass fibre reinforced nylon being preferred. The foamable material was also based on a thermoplastic containing formulation and is preferably one that will also develop adhesive properties as it foams so that it will bond to the interior surface of the metal cavity upon foaming.

Whilst these baffles have enjoyed commercial success in order for them to satisfy the sound insulation requirements of the vehicle in which they are used, there is now a need to improve the acoustic properties of such baffles.

In order to obtain improved acoustic performance of baffles such as those described in Japanese Patent Publications Kokai 10-71628 it would be necessary to increase the thickness of the central plate. This will however undesirably increase the moulding cycle time with attendant manufacturing disadvantages. Furthermore it may require the use of undesirably large amounts of material. We have found that these disadvantages may be overcome whilst allowing the desired acoustic properties to be achieved if upstanding ribs are formed on the plate.

WO 2010/015645 is concerned with how the weight and thickness of the carrier (plate) impacts the manufacturing process and the ability to tailor a baffle. The solution provided by WO 2010/015645 is to modify the baffle by providing an insert within the carrier to increase weight, density and structural rigidity of the baffle without altering the exterior dimensions.

We have now found that the desirable acoustic properties can be obtained with a plate of reduced thickness by the provision of ribs on the surface of the plate and the sound barrier effect and the sealing properties of the baffle can be improved by the provision of the ribs without significantly increasing and perhaps reducing the cycle time for production of the plate by injection moulding.

The present invention therefore provides a baffle suitable for sealing and/or providing sound insulation within a cavity of a vehicle comprising an internal plate provided with a band of foamable material around its perimeter wherein the plate is formed with upstanding ribs.

The plate component of the baffle of the present invention may be formed from any suitable material and formed in any particular manner. It is particularly preferred that it be formed by injection moulding from a strengthened thermoplastic material such as fibre reinforced polyamide or polyolefine such as polypropylene or rigid ethylene homo or copolymers. The preferred ribbed structure that is upstanding from the plate will depend upon the location of the baffle within the automobile and also the performance required of the baffle. Ribs may be provided on one or both sides of the plate and can conveniently be integral with the plate and formed during the injection moulding process.

We have found that the provision of the upstanding ribs on the plate enables the desired improvement in acoustic barrier properties to be obtained with a plate below 5 millimetres in particular below 4 millimetres thickness. The preferred height of the ribs will also depend upon the location of the baffle within the vehicle and the properties it is required to provide. However ribs having a height of from 1 to 60 millimetres preferably 3 to 10 millimetres and a thickness of 1 to 4 millimetres has been found to be particularly useful. The moulding cycle times required for the same mass of material with a ribbed structure is significantly less than the time required for a moulding of uniform thickness.

The plate can also be provided with means of attachment to enable it to be assembled within the vehicle cavity. For example a clip may be integrally moulded with the plate. Typically extending radially outwards in the plate of the plate. In addition the perimeter of the plate may be provided with structures that will operate to secure the foamable material to the

perimeter of the plate. For example grooves, attachment studs and the like may be provided. These embodiments may also be formed during the injection moulding process.

The foamable material is preferably overmoulded around the perimeter of the injection moulded plate. The foamable material will be selected according to the properties the foam is required to impart to the cavity. When the foam is required to provide sealing and/or sound absorption in which case a high expansion, typically 100%-3000% preferably 400-2500% expansion foamable material may be used to produce a soft foam.

In the production of acoustic baffles for automobiles the foamable material is preferably such as to produce a highly expanded soft foam typically from polymers such as ethylene unsaturated ester copolymers typically ethylene vinyl acetate copolymers and/or ethylene acrylate copolymers. In this embodiment a particularly preferred material is an olefinic polymer-based acoustic foam, and more particularly an ethylene based polymer. For example, the foamable material may be based on an ethylene copolymer or terpolymer that may contain a $C_3$ to $C_8$ alpha-olefin comonomer. Examples of particularly preferred polymers include ethylene vinyl acetate copolymers, ethylene acrylate copolymers, EPDM, or mixtures thereof. Other examples of preferred foam formulations that are commercially available include polymer-based materials commercially available from L & L Products, Europe, under the designations as L-2704, L-2806, L-2811, L-2820, L-2821, L-1066, L-2105, L-2106, L-2115, L-2308, L-2411, L-2412, L-2663, L-2664, L-2700, L-2703, L-4161, L-4200, L-4300, L-4315, L-4316, L7102, L7107 and L7220. These materials may be readily injection moulded around the ribbed plate to produce a baffle of this invention.

A number of other suitable materials are known in the art and may also be used for producing foams for noise attenuation and/or vibration damping. One such foam includes an open-cell polymeric base material, such as an ethylene-based polymer which, when compounded with appropriate ingredients (typically a blowing and curing agent), expands and cures in a reliable and predictable manner upon the application of heat or the occurrence of a particular ambient condition. From a chemical standpoint for a thermally activated material, an acoustic foam is usually initially processed as a flowable thermoplastic material before curing. It will preferably cross-link upon curing, which makes the material resistant to further flow or change of final shape.

While the preferred materials for fabricating a sound absorption and/or vibration damping material have been disclosed, the material can be formed of other materials (e.g., foams regarded in the art as structural foams) provided that the material selected is heat-activated

or otherwise activated by an ambient condition (e.g. moisture, pressure, time or the like) and cures in a predictable and reliable manner under appropriate conditions for the selected application.

Some other possible materials include, but are not limited to, polyolefin materials, copolymers and terpolymers, phenol/formaldehyde materials, phenoxy materials, and polyurethanes. U.S. Patent Nos. 5,266,133; 5,766,719; 5,755,486; 5,575,526; 5,932,680; and WO 00/27920 describe suitable materials. In general, the desired characteristics of the resulting foam include relatively low glass transition point, and good corrosion resistance properties. In this manner, the material does not generally interfere with the materials systems employed by automobile manufacturers. Moreover, it will withstand the processing conditions typically encountered in the manufacture of a vehicle, such as the e-coat priming, cleaning and degreasing and other coating processes.

One or more curing agents may be included in the foamable material used in this invention. Optionally curing agent accelerators may also be included. The amounts of curing agents and curing agent accelerators used can vary widely depending upon the type of structure desired, the desired properties of the foamed material and the desired amount of expansion of the foamable material and the desired rate of expansion. Exemplary ranges for the curing agents or curing agent accelerators present in the foamable material range from about 0.001% by weight to about 7% by weight.

Depending upon the function required of the foamed material, it may include one or more additional polymers or copolymers, which can include a variety of different polymers, such as thermoplastics, elastomers, plastomers and combinations thereof. For example, and without limitation, polymers that might be appropriately incorporated into the foamable material include halogenated polymers, polycarbonates, polyketones, polyurethanes, polyesters, and polymers derived from silanes, sulfones, allyls, olefins, styrenes, acrylates, methacrylates, epoxies, silicones, phenolics, rubbers, polyphenylene oxides, terphthalates, acetates (e.g., EVA), acrylates, methacrylates (e.g., ethylene methyl acrylate polymer) or mixtures thereof. Other potential polymeric materials may be or may include, without limitation, polyolefin (e.g., polyethylene, polypropylene) polystyrene, polyacrylate, poly(ethylene oxide), poly(ethyleneimine), polyester, polyurethane, polysiloxane, polyether, polyphosphazine, polyamide, polyimide, polyisobutylene, polyacrylonitrile, poly(vinyl chloride), poly(methyl methacrylate), poly(vinyl acetate), poly(vinylidene chloride), polytetrafluoroethylene, polyisoprene, polyacrylamide, polyacrylic acid, polymethacrylate.

When used, these polymers can comprise a small portion or a more substantial portion of the material. When used, the one or more additional polymers preferably comprises about 0.1% to about 50%, more preferably about 1% to about 20% and even more preferably about 2% to about 10% by weight of the foamable material.

Although not required, the formulation may include one or more ethylene polymers or copolymers such as ethylene acrylate, copolymers and ethylene acetate copolymers. Ethylene methacrylate and ethylene vinyl acetate are two preferred ethylene copolymers.

It may also be desirable to include a reactive polyethylene resin that is modified with one or more reactive groups such as glycidyl methacrylate or maleic anhydride. Examples of such polyethylene resins are sold under the tradename LOTADER® (e.g., LOTADER AX 8900) and are commercially available from Arkema Group.

One or more blowing agents may be used to cause the material to be foamable by producing inert gasses that form, as desired, an open and/or closed cellular structure of the foamed material.

The blowing agent may include one or more nitrogen containing groups such as amides, amines and the like. Examples of suitable blowing agents include azodicarbonamide, dinitrosopentamethylenetetramine, azodicarbonamide, initrosopentamethylenetetramine, 4,4$_i$-oxy-bis-(benzenesulphonylhydrazide), trihydrazinotriazine and N, N$_i$-dimethyl-N,N$_i$-dinitrosoterephthalamide. An accelerator for the blowing agents may also be provided. Various accelerators may be used to increase the rate at which the blowing agents form inert gasses. One preferred blowing agent accelerator is a metal salt, such as an oxide, for example zinc oxide. Other preferred accelerators include modified and unmodified thiazoles or imidazoles. The amounts of blowing agents and blowing agent accelerators that should be used can vary widely depending upon the type of cellular structure desired, the desired amount of expansion the desired rate of expansion and the like. Exemplary ranges for the amounts of blowing agents and blowing agent accelerators in the activatable material range from about 0.001% by weight to about 5% by weight.

The foamable material may also include one or more fillers, including but not limited to particulate materials (e.g., powder), beads, microspheres such as Zeospheres available from Zeelan Industries, or the like. Preferably the filler includes a material that is generally non-reactive with the other components present in the activatable material. While the fillers may

generally be present to take up space at a relatively low weight, it is contemplated that the fillers may also impart properties such as strength and impact resistance.

Examples of fillers that may be used include silica, diatomaceous earth, glass, clay (e.g., including nanoclay), talc, pigments, colorants, glass beads or bubbles, glass, carbon or ceramic fibers, nylon or polyamide fibers (e.g., Kevlar), antioxidants, and the like. Such fillers, particularly clays, can assist in leveling itself during flow of the foamable material. The clays that may be used as fillers may include clays from the kaolinite, illite, chloritem, smecitite or sepiolite groups, which may be calcined. Examples of suitable fillers include, without limitation, talc, vermiculite, pyrophyllite, sauconite, saponite, nontronite, montmorillonite or mixtures thereof. The clays may also include minor amounts of other ingredients such as carbonates, feldspars, micas and quartz. The fillers may also include ammonium chlorides such as dimethyl ammonium chloride and dimethyl benzyl ammonium chloride. Titanium dioxide might also be employed.

In one preferred embodiment, one or more mineral or stone type fillers such as calcium carbonate, sodium carbonate or the like may be used as fillers. In another preferred embodiment, silicate minerals such as mica may be used as fillers.

When employed, the fillers can range from 10 % or less to 90 % or greater by weight of the foamable material, but more typical from about 20 to 55 % by weight of the foamable material. According to some embodiments, the foamable material may include from about 0 % to about 3 % by weight, and more preferably slightly less that 1 % by weight clays or similar fillers. Powdered (e.g. about 0.01 to about 50, and more preferably about 1 to 25 micron mean particle diameter) mineral type filler can comprise between about 5 % and 70 % by weight, more preferably about 10 % to about 50% by weight.

Other additives, agents or performance modifiers may be included in the foamable material as desired, including but not limited to an antioxidant, a UV resistant agent, a flame retardant, an impact modifier, a heat stabilizer, a colorant, a processing aid, a lubricant, a reinforcement (e.g., chopped or continuous glass, ceramic, aramid, or carbon fiber, particulates or the like). Liquid polysufides may be used to improve the environmental exposure such as exposure to humidity and salt water.

In a preferred embodiment the foamable material contains an adhesion promoting material such as a petroleum resin or a synthetic or naturally occurring rosin ester tackifier. The use of these materials can improve the adhesion of the foamable material to the interior walls of

the cavity. It is preferred to include from 0.5 to 10 wt % of such an adhesion promoting material

When determining appropriate components for the foamable material, the material should flow and foam at higher processing temperatures. As an example, temperatures such as those encountered in an automobile assembly plant may be appropriate, especially when the foamable material is processed along with the other components at elevated temperatures or at higher applied energy levels, e.g., during painting preparation steps. In addition it is preferable that the foamable material be non-tacky to the touch at ambient temperature to reduce the pick up of dirt and dust and to facilitate storage and transportation of the baffles.

The amount of foamable material employed around the plate will be determined by the size of the cavity in which the foam is to be provided and the desired degree of expansion. However for most vehicles a layer of foamable material from 1.5 mm to 10 mm thick has been found to be appropriate particularly for the production of a sound absorption and/or vibration damping foam.

The present invention is illustrated by reference to the accompanying drawings in which Figure 1 shows a conventional baffle with a standard thickness plate (1) located within a cavity defined by metal plates based on plates (2) and (3) and having foam (4) around it's perimeter.

Figure 2 is a cross section taken along $AA^1$ of Figure 1.

Figure 3 is a cross section similar to Figure 2 but showing the use of a plate provided with ribs (5).

Figure 4 shows diagrammatic cross sections of baffles provided with various rib structures.

Figure 5 is a plot showing the acoustic performance (decibels transmitted at various frequencies) of

i) a prior art baffle having a 4 millimeter thick plate and no ribs (curve (6));

ii) a baffle of the invention having a 3 millimeter thick plate with 5 millimeter high and 2 millimeter thick ribs in the pattern shown in Figure 6 (curve (7));

iii) a baffle of the invention having a 2 millimeter thick plate with 10 millimeter high and 2 millimeter thick ribs in the pattern shown in Figure 6 (curve (8)).

Accordingly, Figure 5 shows that comparable sound resistance can be achieved with a thinner plate provided with ribs which can be produced employing a shorter moulding cycle.

## CLAIMS

1. A baffle suitable for sealing and/or providing sound insulation within a cavity of a vehicle comprising an internal plate provided with a band of foamable material around it's perimeter wherein the plate is formed with upstanding ribs.

2. A baffle according to Claim 1 in which the plate is formed by injection moulding from a strengthened thermoplastic material such as fibre reinforced polyamide or polyolefine such as polypropylene or rigid ethylene homo or copolymers.

3. A baffle according to Claim 1 or Claim 2 in which the ribs are integral with the plate and formed during the injection moulding process.

4. A baffle according to any of the preceding claims in which the thickness of the plate is below 5 millimetres.

5. A baffle according to Claim 4 in which the thickness is below 4 millimetres.

6. A baffle according to any of the preceding claims in which the ribs have a height of from 1 to 60 millimeters preferably 3 to 10 millimeters.

7. A baffle according to any of the preceding claims in which the ribs have a thickness of 1 to 4 millimetres.

8. A baffle according to any of the preceding claims in which the plate is provided with means of attachment to enable it to be assembled within the vehicle cavity.

9. A baffle according to Claim 8 in which the means of attachment comprises a clip that is integrally moulded with the plate.

10. A baffle according to any of the preceding claims wherein the perimeter of the plate is provided with structures that will operate to secure the foamable material to the perimeter of the plate.

11. A baffle according to any of the preceding claims wherein the foamable material is overmoulded around the perimeter of the injection moulded plate.

12. A baffle according to any of the preceding claims wherein the foamable material has a degree of expansion of 100%-3000%.

13. A baffle according to any of the preceding claims wherein the band of foamable material is from 1.5 mm to 10 mm thick.

14. A baffle according to any of the preceding claims in which the foamable material flows and foams at higher temperatures.

15. The use of upstanding ribs provided on the internal plate of an injection moulded acoustic baffle comprising an internal plate provided with a band of foamable material around its perimeter to enable the baffle to provide the desired acoustic properties whilst reducing the moulding cycle time required for those properties.

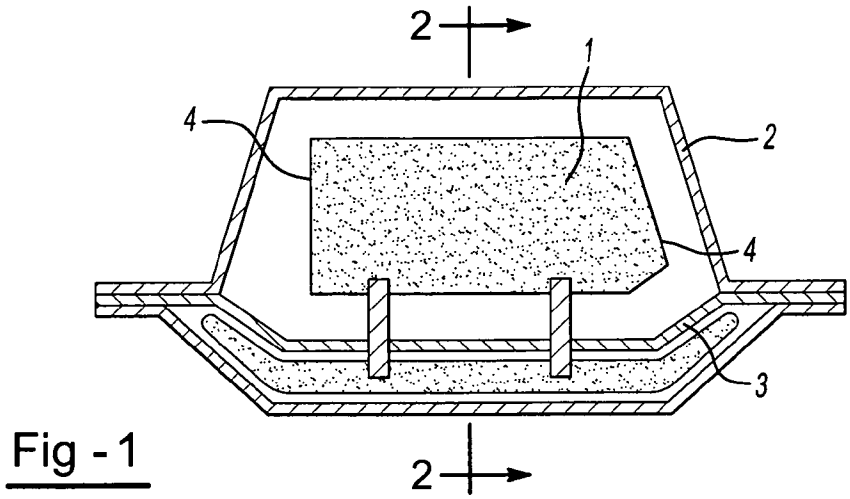


Fig - 1

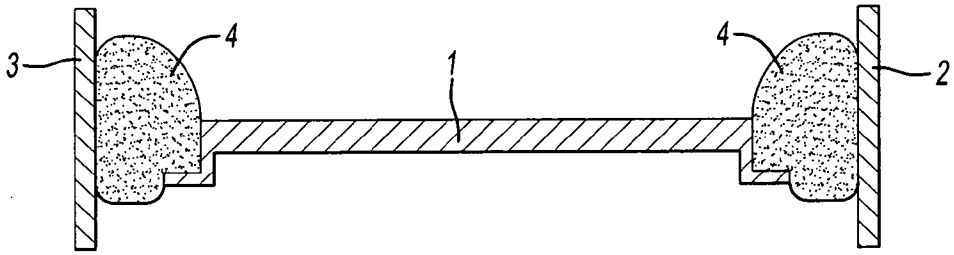


Fig - 2

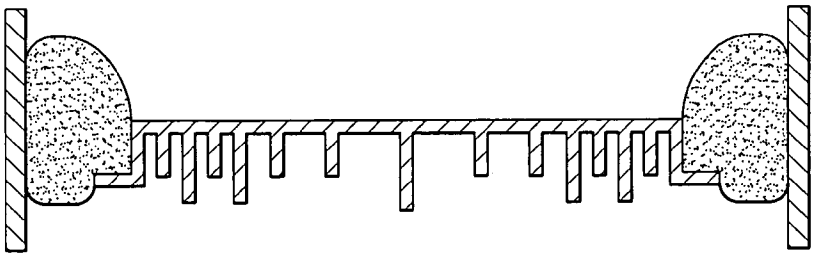

Fig - 3

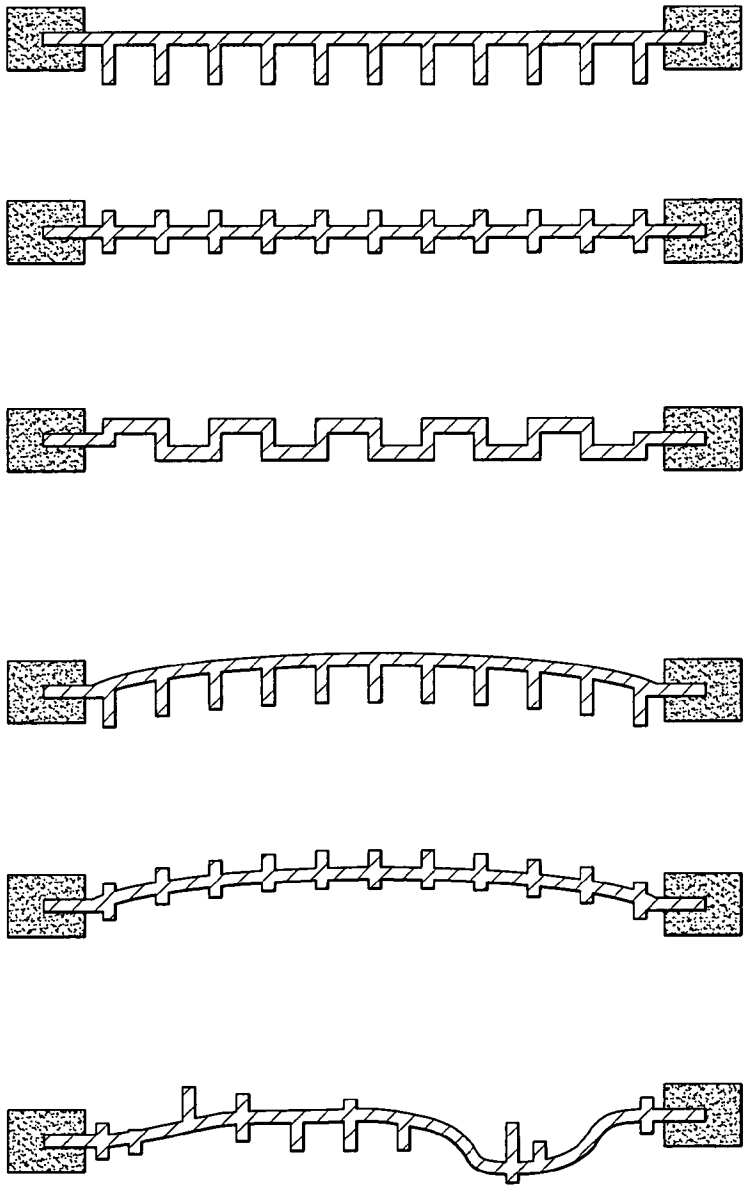

Fig -4

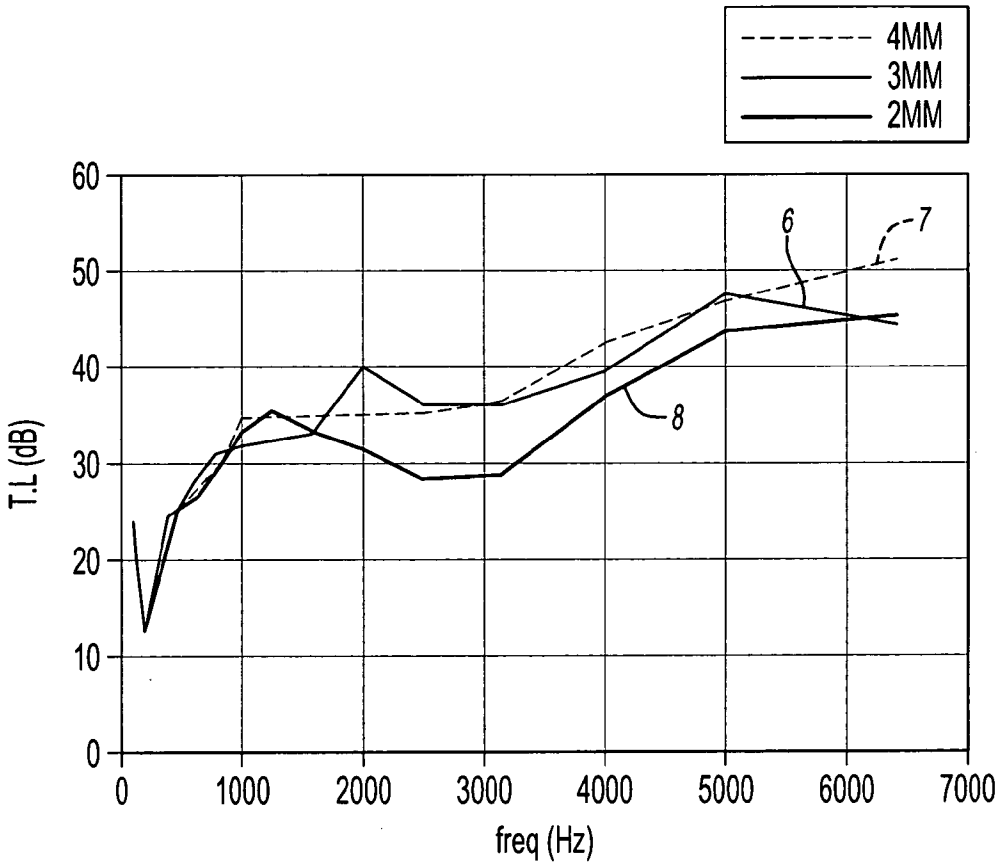
4MM
3MM
2MM
60
50
40
30
20
10
0
T.L (dB)
0
1000
2000
3000
4000
5000
6000
7000
freq (Hz)
6
7
8

Fig - 5

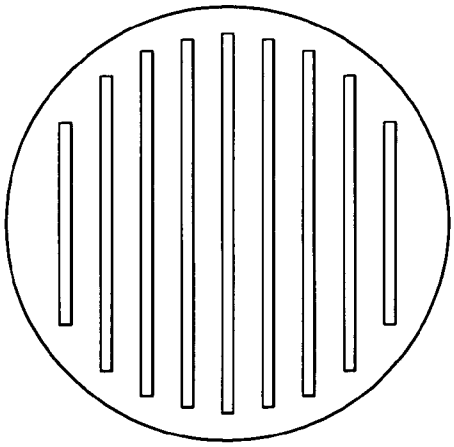

Fig - 6

# INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2012/056848

A. CLASSIFICATION OF SUBJECT MATTER
INV. B62D29/00
ADD.

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)
B62D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| X<br><br>Y | EP 1 593 588 A2 (NITTO DENKO CORP [JP])<br>9 November 2005 (2005-11-09)<br>paragraph [0040]<br>paragraph [0087]; figure 9<br>----- | 1-10,<br>12-15<br>11 |
| Y | EP 1 607 204 A2 (L & L PRODUCTS INC [US])<br>21 December 2005 (2005-12-21)<br>paragraph [0044]; figures<br>----- | 11 |

☐ 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

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"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

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

| Date of the actual completion of the international search | Date of mailing of the international search report |
|---|---|
| 12 July 2012 | 19/07/2012 |

| Name and mailing address of the ISA/ | Authorized officer |
|---|---|
| European Patent Office, P.B. 5818 Patentlaan 2<br>NL - 2280 HV Rijswijk<br>Tel. (+31-70) 340-2040,<br>Fax: (+31-70) 340-3016 | Hageman, Marc |

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/EP2012/056848

| Patent document cited in search report | Publication date | Patent family member(s) | Publication date |
|---|---|---|---|
| EP 1593588 A2 | 09-11-2005 | AT 383296 T | 15-01-2008 |
| | | CN 1693047 A | 09-11-2005 |
| | | DE 602005004197 T2 | 02-01-2009 |
| | | EP 1593588 A2 | 09-11-2005 |
| | | ES 2298878 T3 | 16-05-2008 |
| | | JP 4162624 B2 | 08-10-2008 |
| | | JP 2005319842 A | 17-11-2005 |
| | | US 2005249936 A1 | 10-11-2005 |
| EP 1607204 A2 | 21-12-2005 | CN 1748999 A | 22-03-2006 |
| | | EP 1607204 A2 | 21-12-2005 |
| | | GB 2415162 A | 21-12-2005 |
| | | JP 2006123506 A | 18-05-2006 |
| | | US 2005285292 A1 | 29-12-2005 |