



Europäisches Patentamt
European Patent Office
Office européen des brevets



(11) **EP 1 659 044 A2**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
24.05.2006 Bulletin 2006/21

(51) Int Cl.:
B61D 17/18^(2006.01)

(21) Application number: **05256530.6**

(22) Date of filing: **21.10.2005**

(84) Designated Contracting States:
**AT BE BG CH CY CZ DE DK EE ES FI FR GB GR
HU IE IS IT LI LT LU LV MC NL PL PT RO SE SI
SK TR**
Designated Extension States:
AL BA HR MK YU

(30) Priority: **27.10.2004 JP 2004311686**

(71) Applicant: **HITACHI, LTD.**
Chiyoda-ku
Tokyo 100-8280 (JP)

(72) Inventors:
• **Aota, Kinya**
Hitachi, Ltd., I.P.G.
Tokyo 100-8220 (JP)

- **Watanabe, Makoto**
Hitachi, Ltd., I.P.G.
Tokyo 100-8220 (JP)
- **Horihata, Katutoshi**
Hitachi, Ltd., I.P.G.
Tokyo 100-8220 (JP)
- **Mutoh, Daisuke**
Hitachi, Ltd., I.P.G.
Tokyo 100-8220 (JP)
- **Kinoshita, Shinji**
Hitachi, Ltd., I.P.G.
Tokyo 100-8220 (JP)

(74) Representative: **Paget, Hugh Charles Edward et al**
Mewburn Ellis LLP
York House
23 Kingsway
London WC2B 6HP (GB)

(54) **Sound insulation members of a railroad vehicle, and production methods of sound insulation members**

(57) The invention provides sound insulation members having enhanced sound insulating properties without increasing the thickness of the sound insulation members. The object is achieved by a sound insulation member having disposed inside a pouch-shaped film 1 with a resin coating a flat sound absorption material 2 formed of foamed porous material or fiber material and having its inner space communicated, and filling a filler gas 3 having a sound impedance that differs from air. Accord-

ing to the present invention, since the present sound insulation member is filled with gas having sound impedance that differs from air, the present sound insulation member has superior sound insulating properties since it reflects sound on the sealed surface and also absorbs the sound by the sound absorption material disposed therein.

EP 1 659 044 A2

Description

BACKGROUND OF THE INVENTION

Field of the invention

[0001] The present invention relates to a railroad vehicle, a sound insulation member used as an interior member of the railroad vehicle, and the method for producing the sound insulation member.

Description of the related art

[0002] In railroad vehicles, there are demands to reduce the noise within the vehicles in order to improve the riding quality thereof. Especially in high-speed railroad vehicles such as the Shinkansen (bullet train), the increase of speed causes the noise within the vehicle to increase, so there are demands for sound insulation members with improved performance for reducing the noise within the vehicle body. The conventional sound insulation members for railroad vehicles utilize fiber materials such as glass wool or foamed materials such as polyurethane. The noise within the vehicle body can be reduced by increasing the thickness of the sound insulation members, but the increase of thickness caused the cabin space of the vehicle body to be narrowed.

[0003] Japanese Patent Application Laid-Open Publication No. 2003-70765 (patent document 1) discloses a conventional sound insulation member utilizing a foamed material, wherein a polyurethane material is enclosed in a pouched container which is then vacuumed.

[0004] The prior art sound insulation member disclosed in patent document 1 has its inner space vacuumed, along with which the enclosed polyurethane material is shrunk, resulting in the deterioration of the sound-absorptionability of the polyurethane material. Therefore, the prior art sound insulation member did not exert a satisfactory sound insulating performance.

SUMMARY OF THE INVENTION

[0005] Therefore, the present invention aims at solving the problem by providing a railroad vehicle having an enhanced ride quality without increasing the thickness of the sound insulation member, and a sound insulation member having an enhanced sound insulating performance.

[0006] The above-mentioned problems are solved by providing a railroad vehicle with a sound insulation member having a sound absorption material enclosed in an airtight container and a gas filled airtightly therein.

[0007] According to the present invention, a gas having a sound impedance different from that of air is filled in the container. Sound in atmospheric air has a property to be reflected by gas having a sound impedance that differs from air. Sound impedance is calculated by a product of the sound velocity and the density of gas.

[0008] Therefore, it is preferable that the gas has a sound impedance that differs greatly from air. Typical examples of such gases include helium and carbon dioxide. The purity of the gas should preferably be high so as to ensure a large difference in impedance, but a purity of approximately 90 % is sufficient for practical use.

[0009] The present invention enables to provide a railroad vehicle with a superior ride quality and a wide cabin space by utilizing sound insulation members having superior sound insulation properties.

[0010] The sound insulation member according to the present invention includes gas with a sound impedance different from air filled in a container, wherein the sound insulation properties of the member is enhanced by utilizing both the reflection of sound and the sound absorption effect by the sound absorption material placed therein.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011]

FIG. 1 is a cross-sectional view taken at line (I)-(I') of FIG. 2;

FIG. 2 is a perspective view of a sound insulation member according to the first example of the present invention;

FIG. 3 is a front view showing the state before the sound absorption material is inserted;

FIG. 4 is a front view showing the state after the sound absorption material 2 is inserted;

FIG. 5 is a front view showing the state after the sealing is performed;

FIG. 6 is a view showing the result of measurement of the sound insulation property;

FIG. 7 is a perspective view of the sound insulation member according to a second example of the present invention;

FIG. 8 is a cross-sectional view taken at line (VIII) - (VIII') of FIG. 7;

FIG. 9 is a cross-sectional view taken at line (IX)-(IX') of FIG. 7;

FIG. 10 is a cross-sectional view showing the state in which the sound insulation members are arranged in parallel;

FIG. 11 is a perspective view of a sound insulation member according to a third example of the present invention;

FIG. 12 is a cross-sectional view taken at line (XII) - (XII') of FIG. 11;

FIG. 13 is a cross-sectional view taken at line (XI)-(XI') of FIG. 11;

FIG. 14 is a cross-sectional view showing a fourth example of the present invention;

FIG. 15 is a cross-sectional view of a sound insulation member having triangular grooves formed to one surface thereof;

FIG. 16 is a cross-sectional view of a sound insula-

tion member having arced grooves formed to one surface thereof;

FIG. 17 is a cross-sectional view of a sound insulation member having trapezoidal grooves formed to one surface thereof;

FIG. 18 is a perspective view of the railroad vehicle body;

FIG. 19 is a cross-sectional view showing the area near a side panel according to a sixth example of the present invention;

FIG. 20 is a cross-sectional view showing the area near a side panel according to a seventh example of the present invention;

FIG. 21 is a cross-sectional view of a vehicle according to an eighth example of the present invention;

FIG. 22 is a cross-sectional view showing a sound insulation member according to a ninth example of the present invention;

FIG. 23 is a cross-sectional view showing a seal portion according to the ninth example of the present invention;

FIG. 24 is a cross-sectional view of a seal portion according to a tenth example of the present invention; and

FIG. 25 is a cross-sectional view of a sound insulation member according to an eleventh example of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0012] Sound absorption materials used in the present invention should preferably be formed of foamed porous materials or fiber materials, which are easy to handle. Examples of such materials include those conventionally used as sound absorption materials, such as polyurethane, melamine urethane, polyester, carbon fiber and glass wool.

[0013] Moreover, if the inner space of the sound absorption material is to be vacuumed once before filling helium and other gas so that the inner space of the materials is filled with gas having sound impedance that differs from air, the sound absorption material should preferably have its inner space communicated. Since sound absorption material having its inner space communicated enables gas to be communicated therein, they are preferable for the present invention.

[0014] The sound absorption materials can be of various shapes, such as flat shape, plate shape, powdery shape, floc shape and multiple rod shape. It is especially preferable to use sound absorption materials that can maintain a given shape in order to facilitate manufacture, handling and installation. Moreover, it is preferable for the sound absorption materials to have sufficient flexibility in order to fit the members to the curved inner sides of the vehicle body.

[0015] Furthermore, if foamed porous sound insulation materials are used, it is effective to form a flat sound

absorption material having one smooth surface and an uneven opposite surface. For example, in a railroad vehicle having its body formed of aluminum alloy hollow extruded shape members, if the sound insulation members of the present invention are arranged on a side of the extruded shape members facing the inner side of the vehicle, the flat side can be disposed toward the outer side of the vehicle body and the uneven side can be disposed toward the inner side of the vehicle body, so that the flat side exerts the noise reflection effect caused by the difference in sound impedance and the uneven side absorbs the noise from the inner side of the vehicle, further reducing the noise inside the vehicle.

[0016] If the sound insulation members have an uneven surface disposed to face the direction from which noise is generated, the absorption of noise can be enhanced. Therefore, it is possible to form an uneven surface on the sound insulation members arranged to face the inner side of the vehicle. At this time, by forming the sound absorption materials to have an uneven surface and an inner pressure equal to or lower than atmospheric pressure, it is possible to have the sealing container adhere to the sound absorption members so that the sound insulation members have an uneven surface.

[0017] Furthermore, by utilizing foamed porous sound absorption materials, it is possible both to form an uneven surface to the sound absorption materials and to suppress the solid-state propagation of noise from the aluminum laminate, to thereby improve the sound insulation effect.

[0018] It is preferable for the sound insulation members to be lightweight when applied to railroad vehicles. Therefore, the sealed container used in the present invention should preferably be a pouch.

[0019] Metal foils, especially aluminum foils, are preferably used as the material for forming the pouch because of their low specific gravity. Further, since metal foils being thinner than 6 μm do not have sufficient tolerance to pinholes, they must be thicker than 6 μm to have the inner gas sealed therein and to exert durability. On the other hand, the weight of the metal foils will increase as the thickness increases, so the metal foils should preferably have a thickness within the range of 6 through 50 μm .

[0020] In order to ensure tolerance of the metal foils against bending, it is desirable to use metal laminate films having resin coatings on the metal foils.

[0021] The sound insulation members should desirably be flat, since the object thereof is to insulate noise.

[0022] Furthermore, if gas containing small gas molecules such as helium must be sealed in the member for a long period of time, since small molecules easily penetrate through resin, it is necessary to metallicity cover the portion attached by melting resin via heat seal or the like in order to seal gas.

[0023] Actually, the leak of gas molecules can be prevented by disposing metal backing plates on both sides of the heat seal and welding the backing plates with the

heat seal portion of the film.

[0024] Moreover, by heat-sealing the film in the longitudinal direction to form a cylindrically shaped film via, inserting a flat sound absorption material therein and heat-sealing both ends of the cylindrical film, it is possible to seal gas by heat seals formed to the three edges, which is lighter in weight compared to heat-sealing the four edges.

[0025] If foamed porous sound absorption materials are used, the pressure of the inner gas should be reduced. By reducing the pressure to slightly lower than atmospheric pressure, the shape of the sound absorption materials substantially corresponds to the shape of the sound insulation members, and the size reproducibility of the sound insulation members is thereby improved. The pressure should preferably be lower by at least 1×10^3 Pa than atmospheric pressure which is approximately 1×10^5 Pa. On the other hand, some sound absorption materials may be deformed if the reduced pressure is lower than approximately half the atmospheric pressure or 5×10^4 Pa. Therefore, the internal pressure should be within the range of 5×10^4 Pa through 9.9×10^4 Pa.

[0026] Upon applying sound insulation members formed of foamed porous sound absorption materials to railroad vehicles, since it is difficult to create a large sound insulation member, by forming the ends of flat sound absorption materials to be slanted and overlapping the slanted ends to prevent the formation of gaps between the sound insulation members, the sound insulation members can be applied to railroad vehicles and other large-scale structures.

[0027] In a railroad vehicle with a body formed of aluminum alloy hollow shape members, the sound insulation members according to the present invention can be disposed on the side of the extruded shape members facing the inner side of the vehicle and further having a metal panel disposed on the side of the sound insulation members facing the inner side of the vehicle, the noise inside the vehicle can be further reduced by the double-wall effect realized by the sound insulation members being sandwiched by the hollow extruded shape members and the metal panels.

[0028] According further to a railroad vehicle with a body formed of aluminum alloy hollow shape members, by arranging the sound insulation members with an uneven surface according to the present invention on the surface of extruded shape members facing the inner side of the vehicle with the uneven surface facing the inner side, the sound insulation members can reflect the noise from outside the vehicle and absorb the noise from inside the vehicle, by which the noise inside the vehicle can be reduced effectively.

[0029] Now, the examples of the present invention will be described with reference to the drawings.

[Example 1]

[0030] A first example of the present invention will be described with reference to FIGS. 1 through 6. FIG. 2 is a perspective view of the sound insulation member according to a first example of the present invention, and FIG. 1 is a cross-sectional view taken at (I)-(I') of FIG. 2. In FIG. 1, a sound absorption material 2 and a filler gas 3 are sealed via seal portions 4 formed at both ends of a film 1. The film 1 is an aluminum laminate film in which nylon with a thickness of $20 \mu\text{m}$ is coated on an outer side and polyethylene with a thickness of $40 \mu\text{m}$ is coated on an inner side of an aluminum foil with a thickness of $6 \mu\text{m}$. The aluminum laminate film is formed by adhering resin films on both sides of an aluminum foil via adhesives. Both sides of the aluminum foil are coated with resin to improve the tolerance of the film against bending so as to facilitate handling, and to enable the film to be heat-sealed. By heat-sealing the film 1, a sealed portion 4 is formed to seal the filler gas inside. Helium is used as the filler gas 3. Since the sound impedance of helium differs greatly from that of air, it enhances the reflection of noise at the surface of the sound insulation member and improves the sound insulation effects. The filler gas 3 should have sound impedance that differs from air, and other gases such as carbon dioxide and argon are also effective. Moreover, the pressure of helium should be slightly reduced than atmospheric pressure. This is to enable the shape of the sound absorption material to be substantially equal to the shape of the sound insulation member, and in this example, the absolute pressure of the gas is set to 9×10^4 Pa. Moreover, porous foamed urethane is used as the sound absorption material. This is because urethane has sound absorption properties, and the interior thereof is porous thus communicated, enabling the interior thereof to be replaced with helium.

[0031] Next, we will describe the method for producing the sound insulation members according to the present invention. FIG. 3 shows a plan view of a film prior to having the sound absorption material inserted thereto. Three edges of the film 1 are sealed by a seal portion 4. At this time, the seal portions 4 are curved so that the edges become straight when the sound insulation member is expanded. In this state, the sound absorption material 2 is inserted. FIG. 4 is a front view showing the state in which the sound absorption material 2 is inserted. A pipe 5 is inserted to the film, and a vacuum pump 7 and a helium cylinder 8 are connected thereto via a three-way cock 6. FIG. 5 is a front view showing the sealed state. The film is airtightly sealed by a rubber sealing plate 10 to prevent outer air from entering. A sealing plate is a member composed of rubber, sponge and the like that is designed to prevent gas from leaking when gas is filled via the pipe to the sound insulation member.

[0032] In this state, at first, the interior was vacuumed via the vacuum pump 7 to discharge the gas inside the sound insulation member. Since it is specifically necessary to discharge the air within the porous areas of the

sound absorption material, the interior was vacuumed to 5×10^3 Pa. Thereafter, helium was fed from the helium cylinder 8 until the interior reached a pressure of 9×10^4 Pa.

[0033] FIG. 6 shows the measurement results of the sound insulation properties. The horizontal axis shows the frequency and the vertical axis shows the sound transmission loss. It shows that compared to the prior art sound absorption material 2 used alone, the sound insulation member according to the present invention has superior sound insulation properties.

[0034] Further according to the present embodiment, an aluminum foil can be used as the film 1, and the seal portion 4 can be bonded via ultrasonic bonding or friction stir welding. Since these bonding methods realize metal junction, the bonding has enhanced strength compared to heat-sealed resin.

[Example 2]

[0035] The second example of the present invention will be described with reference to FIGS. 7 through 10. FIG. 7 is a perspective view of the sound insulation member according to the second example of the present invention, FIG. 8 is a cross-sectional view taken at (VIII) - (VIII') of FIG. 7, FIG. 9 is a cross-sectional view taken at (IX) - (IX') of FIG. 7, and FIG. 10 is a cross-sectional view showing the state in which the sound insulation members are arranged in parallel. This example differs from the first example in that the seal portion 4 is formed at one side surface of the sound insulation member. In FIG. 8, the seal portion 4 is arranged at one surface of the flat-shaped sound absorption material 2. Therefore, in the cross-section of (IX) - (IX'), as shown in FIG. 9, it looks as though it is folded. According to this design, as shown in FIG. 10, when three sheets of sound insulation members 11 are arranged in parallel, the sound insulation members 11 can be arranged adjacently without forming gaps, since the seal portion 4 is disposed at one side thereof.

[Example 3]

[0036] FIGS. 11 through 13 illustrate the third example of the present invention. FIG. 11 is a perspective view of the sound insulation member according to example 3 of the present invention, FIG. 12 is a cross-sectional view taken at (XII) - (XII') of FIG. 11, and FIG. 13 is a cross-sectional view taken at (XIII) - (XIII') of FIG. 11. The present example differs from example 1 in that a longitudinal seal portion 4 is disposed on the flat surface of the sound insulation member. According to the present example, compared to example 1, since the seal portion 4 is formed to only three edges, the length of the seal portion can be shortened in total, by which the weight of the member can be reduced.

[Example 4]

[0037] FIG. 14 shows a cross-sectional view of the fourth example of the present invention. The present example differs from example 3 in that the shape of the sound absorption materials 2 is trapezoidal. Since the ends of the sound absorption materials 2 are slanted, no gaps are formed between the materials when the ends are overlapped in parallel, and the transmission of sound through the gaps can be suppressed.

[Example 5]

[0038] FIGS. 15 through 17 illustrate a fifth example of the present invention. FIG. 15 is a cross-sectional view of a sound insulation member having triangular grooves 36 formed to one side thereof, FIG. 16 is a cross-sectional view of a sound insulation member having arched grooves 36 formed to one side thereof, and FIG. 17 is a cross-sectional view of a sound insulation member having trapezoidal grooves 36 formed to one side thereof. This example differs from example 3 in that grooves 36 are formed to the surface of one side of the sound insulation members. The flat side with no grooves 36 enhances the reflection of noise, while the uneven side with the grooves enhances the absorption of noise.

[0039] The uneven surface can be formed by providing projections or grooves to the surface, or by roughening the surface. Especially, the surface in which V-shaped grooves are continuously formed along the longitudinal direction is preferable from the viewpoint of improved sound absorption property and the facilitated production of the sound insulation members.

[0040] Moreover, the angles of the unevenness should be as acute as possible to enhance the sound absorption effects by the multiple reflection of sound in the grooves. However, if they are too acute, the production of the members becomes difficult, the narrow ends reduce the strength of the member (since they are easily bended), and thickness of the sound insulation member is increased. Therefore, the angles are determined based on the material of the inner sound absorption materials, the thickness of the sound insulation members, the inner pressure of the internal gas, and so on. The sound insulation members can be designed in various ways to correspond to the area of the railroad vehicle to which they are to be applied.

[Example 6]

[0041] The sixth example of the present invention will be described with reference to FIGS. 18 through 20. This example shows how the present sound insulation members are applied to railroad vehicles. FIG. 18 is a perspective view of the railroad vehicle body. The railroad vehicle is composed of a roof panel 22, side panels 24, a floor panel 25 and end panels 26. The roof panel 22, the side panels 24 and the floor panel 25 are formed of

aluminum alloy hollow extruded shape members 17. FIG. 19 shows a cross-sectional view of the area near the side panel according to example 6. The side panel 17 is a hollow extruded shape member formed by connecting face plates 15 via ribs 16. On the surface of the side panel 17 facing the inner side of the vehicle are disposed the present sound insulation members 11. Further, a metal plate 18 is disposed on the side of the sound insulation members 11 facing the inner side of the vehicle. The metal plate should be formed of aluminum since it is lightweight. By sandwiching the sound insulation members 11 by the face plate 15 and the metal plate 18, the sound insulation effect is further enhanced by the double wall effect.

[Example 7]

[0042] FIG. 20 shows a seventh example of the present invention. FIG. 20 is a cross-sectional view of the area near the side panel according to the seventh example. This example differs from example 6 in that the surface of the sound insulation members facing the outer side of the vehicle is flat, but the surface facing the inner side of the vehicle is uneven. This structure of the sound insulation member enhances the reflection of noise from outside the vehicle and enhances the absorption of sound from the noise generated inside the vehicle. Thus, the noise level within the vehicle is reduced.

[Example 8]

[0043] FIG. 21 illustrates a railroad vehicle according to the eighth example of the present invention.

[0044] In FIG. 21, the left side shows a cross-section of the portion of the vehicle without a window, and the right side shows a cross-section of the portion with a window. FIG. 21 shows an example in which the sound insulation members are disposed under the window, on the roof and the floor. The hollow extruded shape members forming the vehicle body has substantially arched edges, so in order to maintain a wide internal space, the sound insulation members must be disposed in an arc to correspond to the curvature of the edges. The sound insulation members are attached to the hollow extruded shape members via adhesives, or by sandwiching between the hollow extruded shape members and metal plates 18.

[0045] The size of the sound insulation members can be, for example, approximately 700 mm in height, 1000 mm in length and 50 mm in thickness on the side walls under the window. The longitudinal direction of the sound insulation members are disposed to correspond to the longitudinal direction of the vehicle.

[0046] The sound insulation members must be produced to correspond to the shapes of the vehicle body. According to the sound insulation members of the present invention, as shown in FIG. 21, the sound insulation members with various cross-sectional shapes can

be produced easily by changing the shapes of the inner structures of the members.

[0047] Furthermore, since the sound insulation members of the present invention are composed of communication members, films and inner gas, the inner structures can be formed of elastic materials so that the sound insulation members have elasticity, which enables the members to be bent in an arc for use.

[Example 9]

[0048] The ninth example of the present invention is described with reference to FIGS. 22 and 23. FIG. 22 is a cross-sectional view of the sound insulation member according to example 9, and FIG. 23 is a cross-sectional view of a seal portion according to example 9. This example differs from example 1 in that backing plates 30 are arranged on both side of the seal portions 4, and the seal portions 4 and backing panels 30 are welded together. The backing plate 30 is an aluminum plate with a thickness of 0.2 mm, and is welded via friction stir welding. When the gas to be filled has small molecules such as helium, the molecules easily pass through the polyethylene layer 31 of the seal portions 4, so that during long terms of use, the helium gradually leaks out, deteriorating the properties of the sound insulation members. In such case, it is effective to metalically weld the aluminum foils 33 of the films 1 at weld portions 35. Therefore, the welding can be performed also via laser welding or resistance welding, as long as they are metalically welded.

[0049] Especially since the objects to be welded or films 1 are thin, the welding should preferably be performed via friction stir welding, laser welding or resistance seam welding.

[Example 10]

[0050] FIG. 24 shows a tenth example of the present invention. FIG. 24 is a cross-sectional view of the seal portion according to the tenth example. Example 10 differs from example 1 in that an insert material 34 is disposed at the outer circumference end of the seal portion 4, and backing plates 30 are disposed on both sides of the insert material, which are subjected to welding by which the seal portion 4 and the backing plates 30 are welded. The insert material 34 and the backing plates 30 are aluminum panels having a thickness of 0.2 mm, and the seal portion 4, the insert material 34 and the backing plates 30 are welded via friction stir welding. As a result, the leaking of helium can be prevented and the performance of the sound insulation member will not deteriorate even after a long period of use.

[Example 11]

[0051] FIG. 25 shows an eleventh example of the present invention. FIG. 25 is a cross-sectional view of the sound insulation member according to the eleventh

example of the invention. Inside the sound insulation member is disposed a sound absorption material 2 having a curved uneven surface 36. The material of the sound absorption material 2 is foamed porous urethane. Helium is sealed in an aluminum laminate film 1 together with the sound absorption material 2. According to the present invention, uneven surfaces 36 are formed on both the front and back surfaces of the sound absorption material 2, so that there is only a small contact area between the film 1 and the sound absorption material 2. This arrangement enables to suppress the transmission of sound being incident on the film 1 to the sound absorption material 2 via solid state propagation. The uneven surface 36 contributes to reducing the sound being transmitted through the sound insulation member of the present invention. The shapes of the uneven surface can be triangular, as long as the uneven surface 36 serves to reduce the contact area with the film 1. It is best that the uneven surface 36 contacts the film 1 via point contact, so the shapes of the uneven surface should preferably be a hemisphere or a triangular prism.

Claims

1. A railroad vehicle having a vehicle body formed of metal and a sound insulation member disposed on a side of the vehicle body facing an inner side of the vehicle, wherein the sound insulation member comprises a sealing container, a sound absorption material disposed inside the sealing container, and a gas filled inside the sealing container having a density or sound velocity different from that of atmospheric air.
2. A railroad vehicle having a vehicle body formed of metal and a sound insulation member disposed on a side of the vehicle body facing an inner side of the vehicle, wherein the sound insulation member comprises a pouched member formed of a metal foil, a sound absorption material covered by the pouched member, and a gas filled inside the pouched member having a density or sound velocity different from that of atmospheric air.
3. The railroad vehicle according to claims 1 or 2, wherein the sound insulation member has a trapezoidal cross-sectional shape, and multiple sound insulation members are arrayed with slanted trapezoidal edges fit against one another.
4. The railroad vehicle according to claims 1, 2 or 3, wherein the sound insulation member has an uneven surface provided at least on a surface facing the inner side of the vehicle.

5. The railroad vehicle according to any one of claims 1 to 4, wherein the sound absorption material is either a foamed porous material or a fibermaterial having its inner space communicated.
6. The railroad vehicle according to any one of claims 1 to 5, wherein the gas contains either 90% or more helium or 90% or more carbon dioxide.
7. The railroad vehicle according to any one of claims 1 to 6, wherein the sound absorption material is flat shaped and having an uneven surface formed to one surface thereof.
8. The railroad vehicle according to any one of claims 1 to 7, wherein the gas sealed inside the member has a pressure lower than atmospheric pressure.
9. A sound insulation member comprising a pouched member formed of a metal foil having a resin coating, and a foamed porous material or a fiber material enclosed in the pouched member, wherein a gas is filled in the pouched member and airtightly sealed therein.
10. The sound insulation member according to claim 9, wherein the foamed porous material or the fiber material is a solid, flat-shaped material.
11. The sound insulation member according to claim 9 or 10 wherein the metal foil is an aluminum foil having a thickness of 6 μm or greater.
12. The sound insulation member according to claim 9, 10 or 11, wherein the foamed porous material or the fiber material includes polyurethane, melamine urethane, polyester, carbon fiber polyurethane or glass wool.
13. The sound insulation member according to any one of claims 9 to 12, wherein the foamed porous material or the fiber material is flat-shaped and has an uneven surface.
14. The sound insulation member according to any one of claims 9 to 13, wherein the foamed porous material or the fiber material is flat-shaped, and either an upper surface or a lower surface thereof has a wider surface area than the opposite surface.
15. The sound insulation member according to any one of claims 9 to 14, wherein the gas is of reduced-pressure atmosphere having a pressure 1×10^3 Pa or more lower than atmospheric-

ic pressure.

- 16.** The sound insulation member according to any one of claims 9 to 15, wherein the foamed porous material or the fiber material has a trapezoidal cross-sectional shape. 5
- 17.** A railroad vehicle comprising the sound insulation member according to any one of claims 9 to 16. 10
- 18.** A method for producing a sound insulation member comprising:
- forming a pouched member having one portion opened with a metal foil coated with resin; 15
 - enclosing a member having a sound absorption function and a gas having a density or sound velocity different from that of atmospheric air in the pouched member; 20
 - sealing the opened portion of the pouched member via heat seal; and 25
 - disposing backing plates on upper and lower sides of the heat seal surface and welding the metal foils with the backing plates. 30
- 19.** A method for producing a sound insulation member comprising:
- forming a cylindrical member by heat-sealing a metal foil along a longitudinal direction; 35
 - inserting a sound absorption material having a sound absorption function to the cylindrical member; and 40
 - sealing both ends of the cylindrical member via heat seal. 45
- 50
- 55

FIG. 1

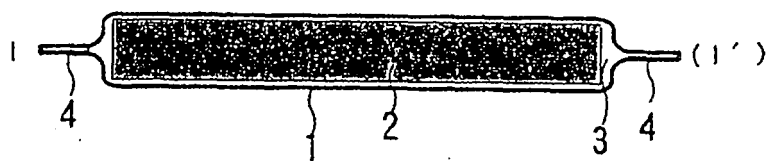


FIG. 2

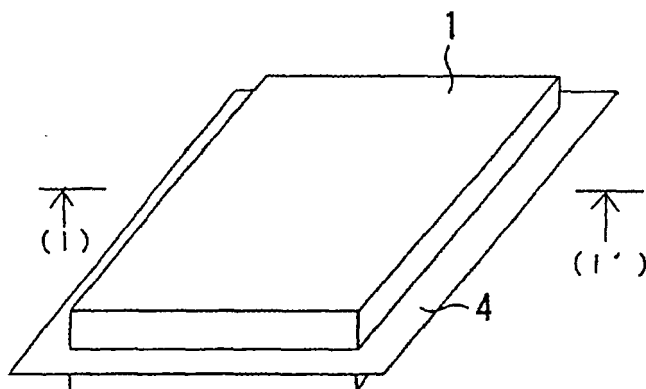


FIG. 3

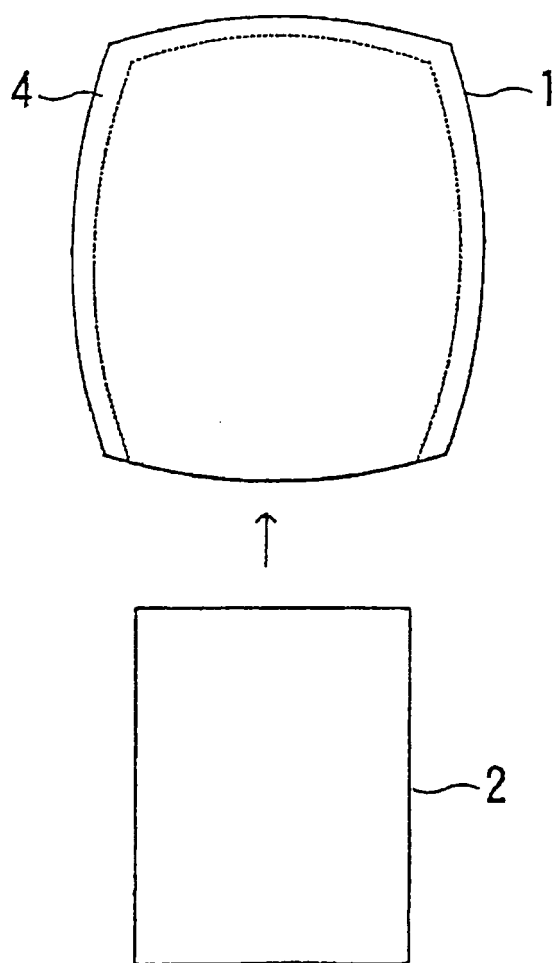


FIG. 4

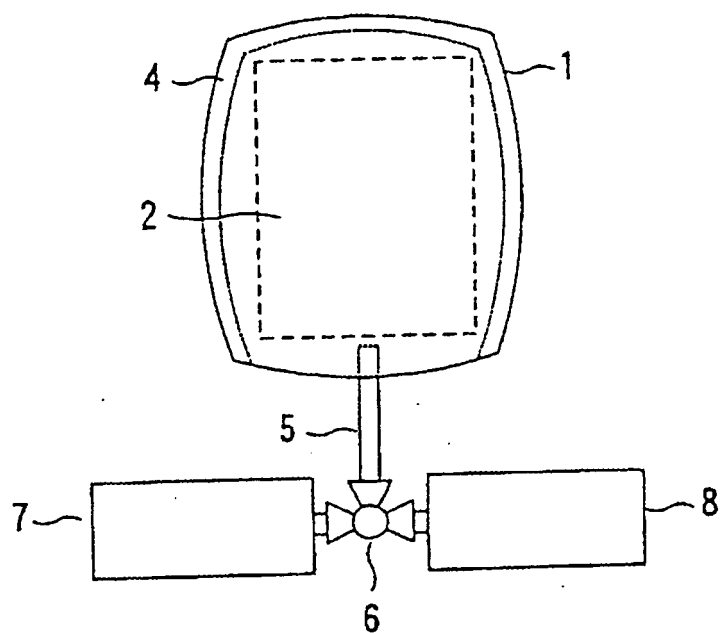


FIG. 5

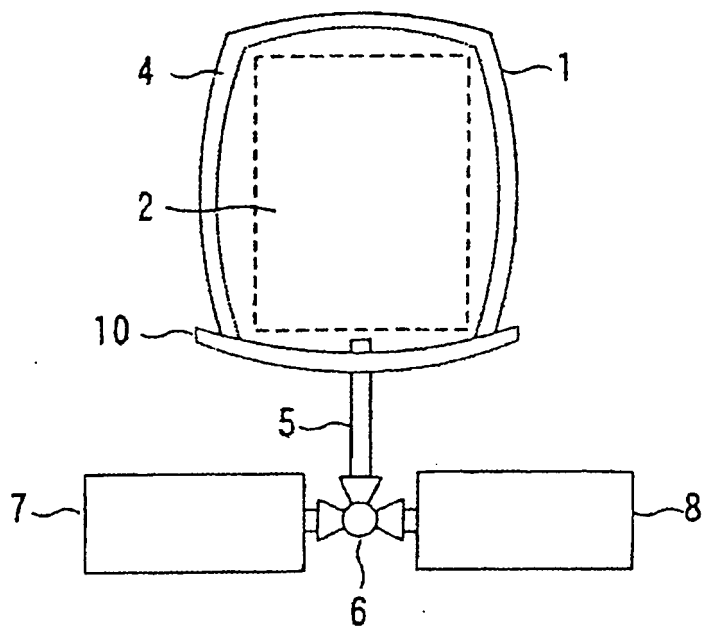


FIG. 6

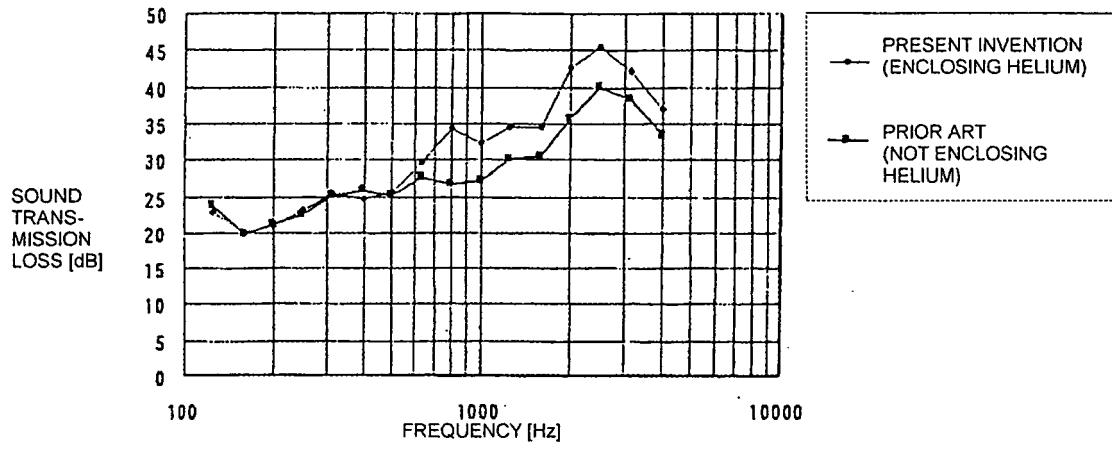


FIG. 7

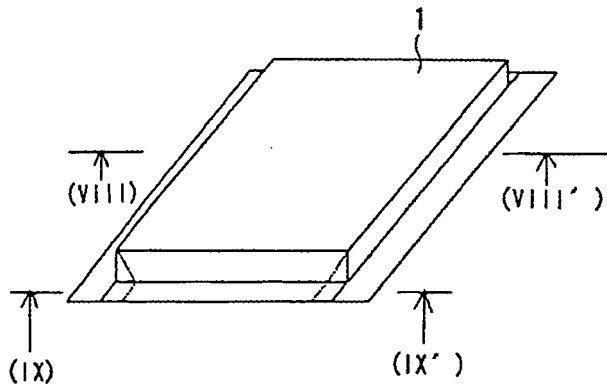


FIG. 8

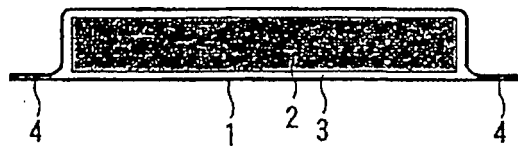


FIG. 9



FIG. 10



FIG. 11

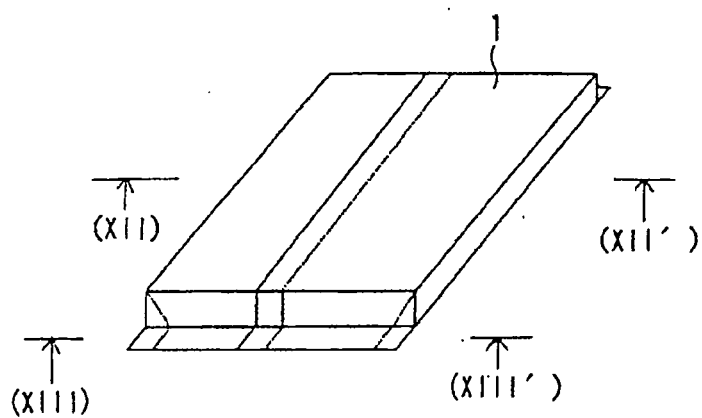


FIG. 12

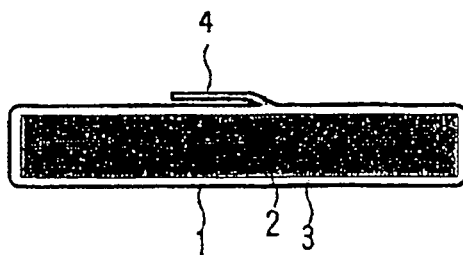


FIG. 13



FIG. 14

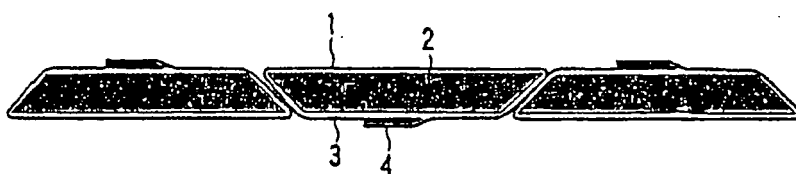


FIG. 15

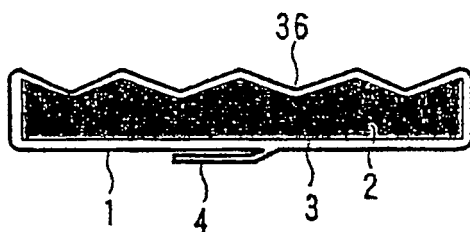


FIG. 16

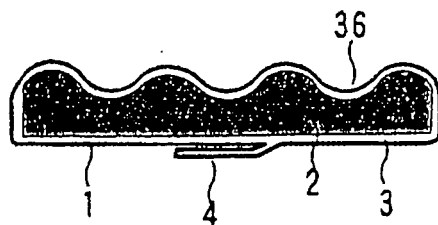


FIG. 17

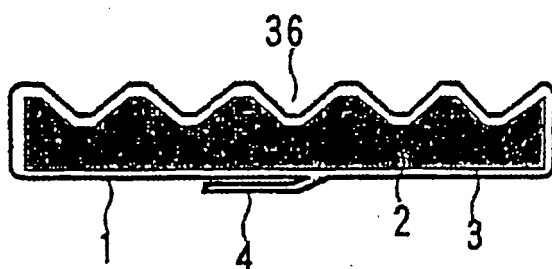


FIG. 18

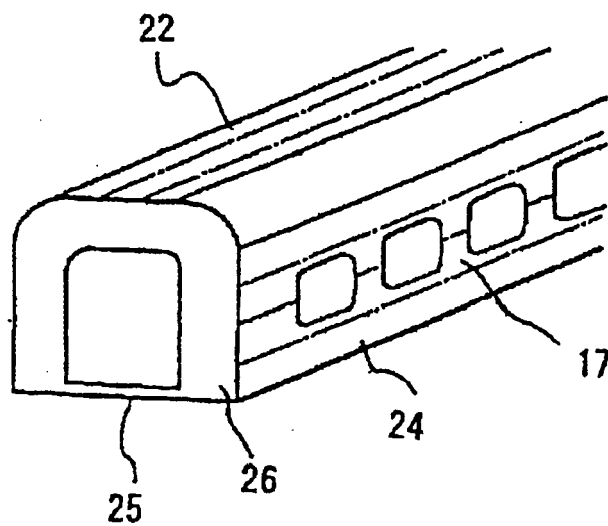


FIG. 19

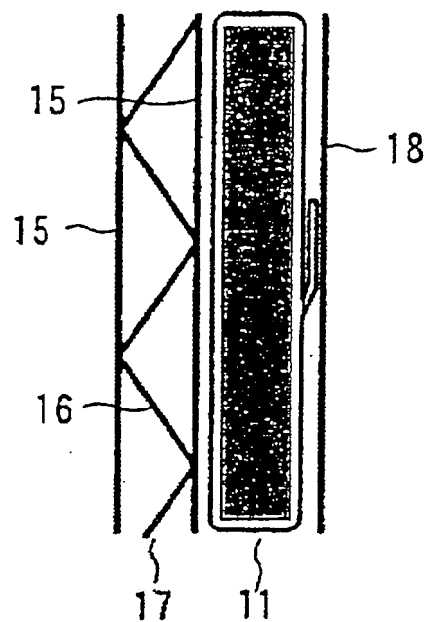


FIG. 20

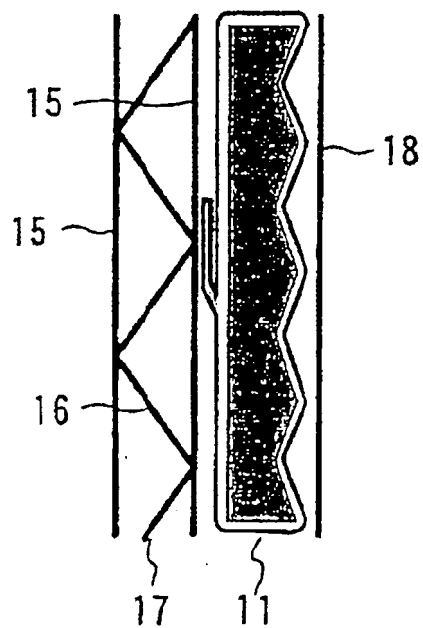


FIG. 21

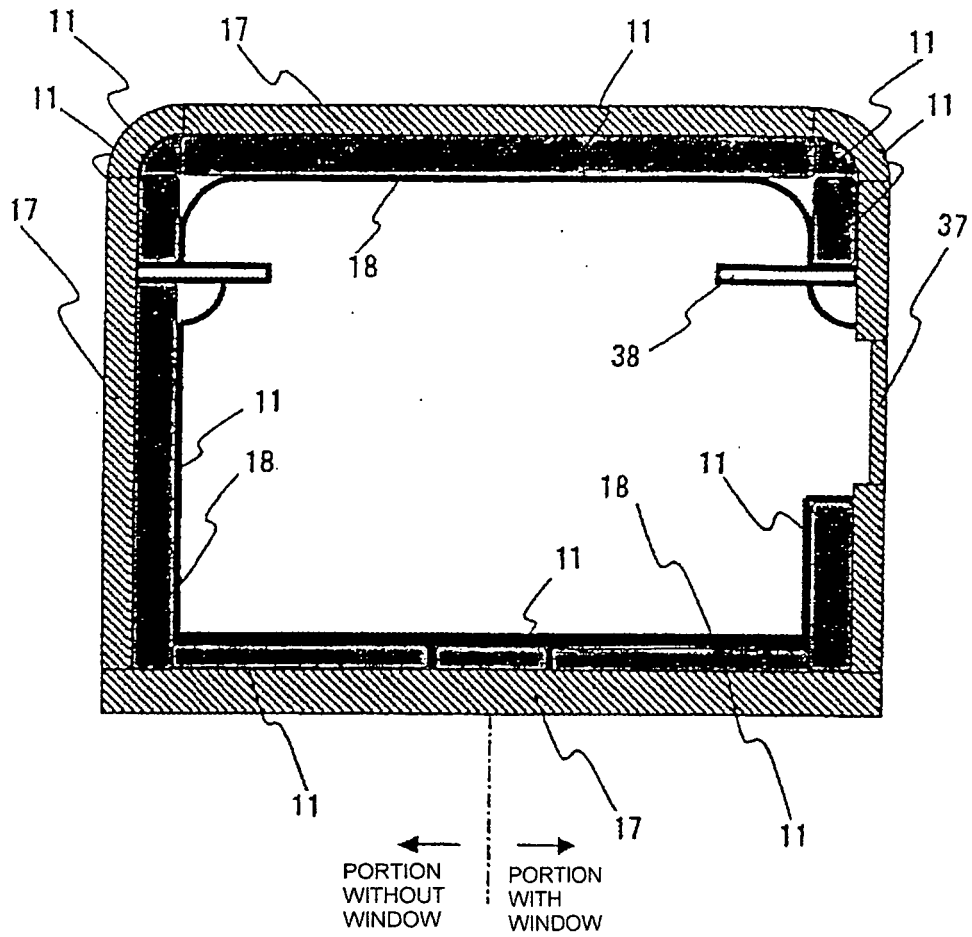


FIG. 22

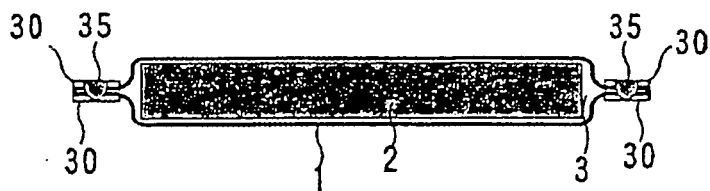


FIG. 23

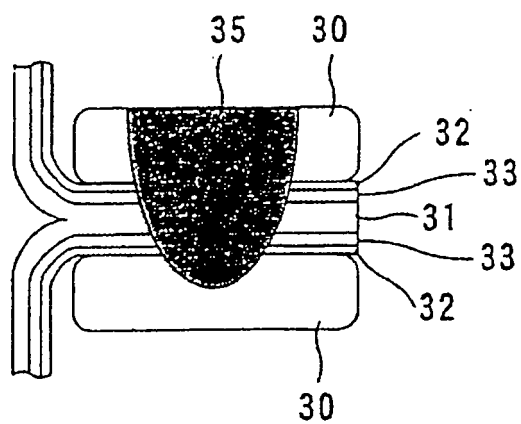


FIG. 24

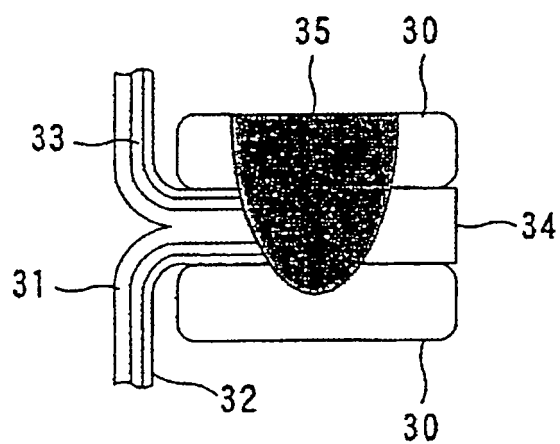


FIG. 25

