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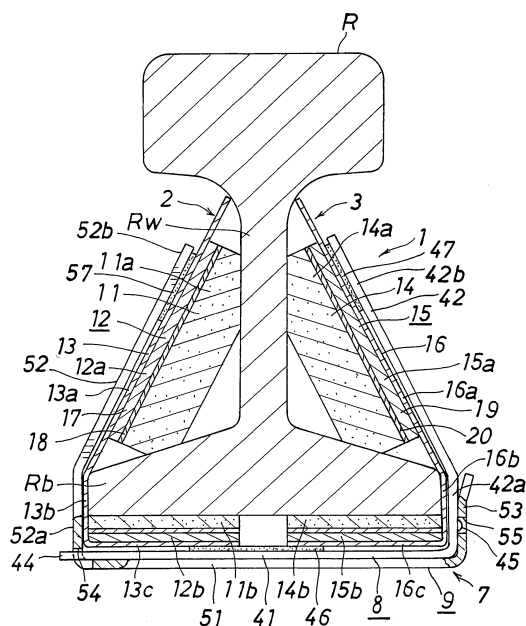
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(54) **NOISE INSULATION DEVICE FOR RAIL**

(57) A noise insulation device for a rail provided herein requires no tool for bolt fixation or screw fixation and is therefore capable of making works less tedious and less complex and solves a problem that a portion overhanging from the rail interferes with rail maintenance by reducing the overhanging portion. A noise insulation device 1 for a rail includes a first noise insulation member 2, a second noise insulation member 3, and a fastener 7. The fastener 7 is formed of a first fastening member 8 and a second fastening member 9. The first fastening member 8 has a horizontal portion 41 inserted under a lower surface of a rail bottom and a rising portion 42 provided so as to continue from an end of the horizontal portion 41 and fit to a sound insulation cover 13 of the first noise insulation member 2. The second fastening member 9 has a horizontal portion 51 inserted under the lower surface of the rail bottom and a rising portion 52 provided so as to continue from an end of the horizontal portion 51 and fit to a sound insulation cover 16 of the second noise insulation member. The first fastening member 8 and the second fastening member 9 are fit together in a re-attachable manner.

Fig. 1



Description

Technical Field

[0001] The present invention relates to a noise insulation device for a rail, and more particularly, to a noise insulation device for a rail including a fastener used to fasten noise insulation members to a rail.

Background Art

[0002] As a noise insulation device for a rail in the related art including a fastener used to fasten noise insulation members to a rail, there is proposed a noise insulation device including a first noise insulation member having a sound absorption mat and a sound insulation cover and attached to a necessary part on a rail surface from one side, a second noise insulation member having a sound absorption mat and a sound insulation cover and attached to a necessary part on the rail surface from the other side, and a fastener used to fasten the both noise insulation members.

[0003] According to those described in Patent Documents 1 and 2, the fastener is formed of two fastening members and these fastening members are stacked on a side in a lower surface of a rail bottom and fixed with bolts. According to the one described in Patent Document 3, the fastener is fixed with screws.

Cited List

Patent Documents

[0004]

Patent Document 1: JP-A-2007-224700

Patent Document 2: JP-A-2006-2442

Patent Document 3: JP-A-2008-95408

Summary of the Invention

Problems that the Invention is to Solve

[0005] The one described in Patent Document 3 requires a tool for screw fixation and therefore has a problem that workability is poor. Those described in Patent Documents 1 and 2 employ bolt fixation and workability is good in comparison with screw fixation. However, a tool is required for the work. In addition, because a stacked portion for bolt fixation overhangs from the rail, there is a problem that this overhanging portion interferes with rail maintenance.

[0006] An object of the invention is to provide a noise insulation device for a rail requiring no tool for bolt fixation or screw fixation and therefore capable of making works less tedious and less complex and also solving a problem that a portion overhanging from the rail interferes with rail maintenance by reducing the overhanging portion.

Means for Solving the Problem

[0007] A noise insulation device for a rail of the invention includes a first noise insulation member having a sound absorption mat and a sound insulation cover and attached to a necessary part on a rail surface from one side, a second noise insulation member having a sound absorption mat and a sound insulation cover and attached to a necessary part on the rail surface from the other side, and a fastener used to fasten the both noise insulation members, and is characterized in that: the fastener is formed of a first fastening member and a second fastening member; the first fastening member has a horizontal portion inserted beneath a lower surface of a rail bottom and a rising portion provided so as to continue from an end of the horizontal portion and fit to the sound insulation cover of one of the noise insulation members; the second fastening member has a horizontal portion inserted beneath the horizontal portion of the first fastening member and a rising portion provided so as to continue from an end of the horizontal portion and fit to the sound insulation cover of the other one of the noise insulation members; and at least one convex portion is provided to one of the first and second fastening members and a concave portion to be fit together with the convex portion is provided to the other one of the fastening members, so that the first fastening member and the second fastening member are fit together in a re-attachable manner with the respective horizontal portions being stacked.

[0008] In order to fasten two noise insulation members using two fastening members, it is generally necessary to provide fastened portions to the respective fastening members and to connect the fastened portions with bolts. However, not only by forming each fastener in a shape having the horizontal portion and the rising portion, but also by configuring in such a manner that the first fastening member and the second fastening member are fit together in a re-attachable manner, it becomes possible to eliminate the fastening by bolts and the fastened portions of the fasteners provided for the fastening. Accordingly, no tool is required for bolt fixation or screw fixation, which can in turn make works less tedious and less complex, and also a problem that a portion overhanging from the rail interferes with rail maintenance can be solved by reducing the overhanging portion.

[0009] It is preferable that the portion overhanging from the rail is within 10 mm from the rail bottom. This condition can be fulfilled easily by fastening the noise insulation members using the two fastening members as described above.

[0010] The configuration by which the fastening members are fit together in a re-attachable manner can be achieved, for example, by providing at least one convex portion to one of the first and second fastening members (the horizontal portion and/or the rising portion thereof) and providing a concave portion to be fit together with the convex portion to the other member. The numbers

and shapes of the convex portion and the concave portion are not particularly limited. For example, it may be configured in such a manner that one convex portion is provided to one member and one concave portion to the other member or two convex portions are provided to one member and two concave portions to the other member. Further, it may be configured in such a manner that one convex portion and one concave portion are provided to one member and one convex portion to the other member. In addition, it may be configured in such a manner that one portion is formed in a corrugated or serrated shape and the other portion is formed in a corresponding corrugated or serrated shape. It should be appreciated that the concave portion does not necessarily have a bottom surface in abutment with the tip end surface of the convex portion and the concave portion may be a hole or a slit.

[0011] It is preferable that at least one of the first and second fastening members is provided with a bent portion formed at an end of the horizontal portion on an opposite side to the rising portion so as to restrict a movement of the fastening member toward the rising portion.

[0012] The fastening member provided with the bent portion can sandwich the sound insulation member from the both sides of the rail bottom surface with the rising portion and the bent portion. It thus becomes possible to achieve a certain degree of fastening without the other fastening member, and further firmer fastening can be achieved when this fastening member is combined with the other fastening member.

[0013] It is preferable that the bent portion is provided to the second fastening member and brought into abutment with the rising portion of the first fastening member from an outer side. When configured in this manner, movements of the both first and second fastening members in a direction orthogonal to the rail are prevented, which makes the fastening firm.

[0014] It is preferable that the at least one convex portion includes a first convex portion provided on an outer surface of the rising portion of the first fastening member, and that a first concave portion to be fit together with the first convex portion is provided to the bent portion of the second fastening member. When configured in this manner, in addition to the function of preventing movements of the respective fastening members in a direction orthogonal to the rail by the bent portion, it becomes possible to achieve a function of preventing movements of the respective fastening members in a direction orthogonal to the rail by the first convex portion and the first concave portion that are fit together, which makes the fastening firmer.

[0015] It is preferable that the at least one convex portion includes a second convex portion provided so as to protrude in a horizontal direction from the end of the horizontal portion of the first fastening member on the opposite side to the rising portion, and that a second concave portion to be fit together with the second convex portion is provided at a lower end of the rising portion of

the second fastening member. When configured in this manner, the respective two convex portions and the corresponding two concave portions are fit together so that a relative movement of the respective fastening members in a rail length direction is prevented in a reliable manner. Positioning is thus performed in a reliable manner.

[0016] A method of attaching the noise insulation device for a rail in which the second convex portion and the second concave portion are fit together (claim 5) to a rail includes: a step of installing the first fastening member by inserting the horizontal portion of the first fastening member beneath the lower surface of the rail bottom from one side of the rail; a step of installing the second fastening member by inserting the horizontal portion of the second fastening member beneath the horizontal portion of the first fastening member from the other side of the rail for the second concave portion of the second fastening member and the second convex portion of the first fastening member to be fit together in such a manner that there is no clearance between the end of the horizontal portion of the first fastening member on the opposite side to the rising portion and an end of the second fastening member on a side of the rising portion whereas there is a clearance between an end of the horizontal portion of the first fastening member on the side of the rising portion and an end of the horizontal portion of the second fastening member on a side of the bent portion; and a step of eliminating the clearance between the end of the horizontal portion of the first fastening member on the side of the rising portion and the end of the second fastening member on the side of the bent portion using a bar-like tool given that one end of the tool is a pivot point and the other end of the tool is a point of effort by bringing an intermediate portion of the tool in abutment with the end of the horizontal portion of the second fastening member on the side of the bent portion from below and applying an upward force to the point of effort.

[0017] It may be configured in such a manner that the at least one convex portion includes a first convex portion provided to the horizontal portion of one of the first and second fastening members, and that a first concave portion to be fit together with the first convex portion is provided to the horizontal portion of the other one of the fastening members.

[0018] In this case, it is preferable that the horizontal portion of one of the first and second fastening members is provided with a guide portion that guides the horizontal portion of the other one of the fastening members when the horizontal portion of the other one of the fastening members is stacked thereon and also restricts a movement of the horizontal portion of the other one of the fastening members in a rail length direction after the horizontal portions are stacked.

[0019] When configured in this manner, the horizontal portion is guided by the guide portion when the first fastening member and the second fastening member are fit together. Hence, because displacement is prevented, the fastening members can be fit together easily. Also,

because the guide portion and the horizontal portion are fit together, the first fastening member and the second fastening member become more resistant to separation.

[0020] More preferably, a convex portion is provided to the horizontal portion of one of the first and second fastening members and a concave portion to be fit together with the convex portion is provided to the horizontal portion of the other fastening member. In addition, the bent portion and the guide portion are provided to the first fastening member. When configured in this manner, a relative movement of the both fastening members can be suppressed by fitting the convex portion and the concave portion together. Moreover, a movement of the first fastening member in a rail width direction is suppressed by the bent portion, and a movement of the second fastening member in the rail length direction is suppressed by the guide portion of the first fastening member. Hence, the first fastening member and the second fastening member are connected firmly and the noise insulation members are fastened extremely firmly.

[0021] It may be configured in such a manner that the sound insulation cover is formed in a shape of a flat plate bridged between an upper end of a side surface of a rail waist and a tip end of an upper surface of the rail bottom. Also, it may be configured in such a manner that the sound insulation cover has a slope portion extending from an upper end of a side surface of a rail waist to a tip end of an upper surface of the rail bottom, a vertical portion extending from a lower end of the slope portion along a side surface of the rail bottom, and a horizontal portion extending from a lower end of the vertical portion along a lower surface of the rail bottom, and that the sound absorption mat is provided to both of the slope portion and the horizontal portion. The former configuration has an advantage that the configuration of the noise insulation members can be simpler. The latter configuration has an advantage that the noise insulation effect can be further enhanced by the sound absorption mat and the sound insulation cover provided to the lower surface of the rail bottom.

[0022] It is preferable that the vertical portion of the sound insulation cover is provided with a convex portion that prevents displacement of the respective fastening members in a rail direction. When configured in this manner, it becomes possible to prevent the fastener from displacing in the rail length direction in a reliable manner.

[0023] It is preferable that the sound absorption mat is formed of at least one of a fibrous sound absorbing material, a resin foam of sound absorbing material, an open-celled foam of sound absorbing material, an inorganic porous sound absorbing material, and an inorganic particle sintered sound absorbing material. In terms of the noise insulation effect and ease of handling, a fibrous sound absorbing material, such as glass wool and rock wool, and a resin foam of sound absorbing material, such as urethane foam, EPDM foam, and polyethylene foam, is more preferable.

[0024] It is also preferable that the sound insulation

cover is formed of at least one of a metal plate, a resin plate, and an inorganic plate. In terms of ease of processing, long-term durability, and mechanical strength, it is preferable to use an erosion resistant steel plate, such as a Galvalume steel plate, and a plated sheet steel of molten zinc-aluminum-magnesium alloy.

[0025] A surface density and a thickness of the sound insulation cover are not particularly limited. However, a surface density of 0.5 to 15 kg/m² and a thickness of 0.1 to 2.0 mm are preferable.

[0026] A length of the sound insulation cover is not particularly limited. Assume that one sound insulation cover is provided at every sleeper interval, then in a site adopting a typical sleeper interval of 550 to 600 mm, the length of the sound insulation cover is preferably 600 to 650 mm. The sleeper interval in an actual site of work has a variance of about 50 mm. Hence, by setting the length to 600 to 650 mm for the site adopting the sleeper interval of 550 to 600 mm, it becomes possible to install the covers without leaving any clearance by overlapping the adjacent covers. When consideration is given to this manner of installation to overlap the sound insulation covers, a thickness of the sound insulation cover is preferably 0.1 to 2.0 mm as specified above.

[0027] A position at which the upper peripheral portion of the sound insulation cover is in contact with the rail surface is not particularly limited to a position 38 mm below the upper surface of the rail head top as long as the position does not reach a construction gauge set in the horizontal direction. It is, however, preferable that the upper peripheral portion is in contact with the rail surface at a position 42 to 62 mm below the upper surface of the rail top head.

[0028] A damping sheet may be interposed between the sound absorption mat and the sound insulation cover. The damping sheet in this case preferably has a coefficient of loss of 0.1 or higher, and for example, has a double-layer structure formed of a damping resin layer and a constrained layer.

Advantages of the Invention

[0029] According to the noise insulation device for a rail of the invention, the first fastening member has the horizontal portion inserted beneath the lower surface of the rail bottom and the rising portion provided so as to continue from the end of the horizontal portion and fit to the sound insulation cover of one of the noise insulation members, and the second fastening member has the horizontal portion inserted under the lower surface of the rail bottom and the rising portion provided so as to continue from the end of the horizontal portion and fit to the sound insulation cover of the other one of the noise insulation members, so that the first fastening member and the second fastening member are fit together in a re-attachable manner with the horizontal portion of the former and the horizontal portion of the latter being stacked. Hence, no tool is required for bolt fixation or screw fixation, which

can in turn make works less tedious and less complex, and also a problem that a portion overhanging from the rail interferes with rail maintenance can be solved by reducing the overhanging portion.

Brief Description of the Drawings

[0030]

[Fig. 1] Fig. 1 is a cross section showing a first embodiment of a noise insulation device for a rail of the invention.

[Fig. 2] Fig. 2 is a perspective view of a first fastening member of a fastener in the noise insulation device for a rail of the first embodiment.

[Fig. 3] Fig. 3 is a perspective view of a second fastening member of the fastener in the noise insulation device for a rail of the first embodiment.

[Fig. 4] Fig. 4 is a view showing an attachment method of the noise insulation device for a rail of the first embodiment.

[Fig. 5] Fig. 5 is a side view showing a preferred embodiment of a sound insulation cover in the noise insulation device for a rail of the first embodiment.

[Fig. 6] Fig. 6 is perspective views showing preferred embodiments of the sound insulation cover in the noise insulation device for a rail of the first embodiment.

[Fig. 7] Fig. 7 is a cross section showing a second embodiment of the noise insulation device for a rail of the invention.

[Fig. 8] Fig. 8 is a perspective view of a first fastening member of a fastener in the noise insulation device for a rail of the second embodiment.

[Fig. 9] Fig. 9 is a perspective view of a second fastening member of the fastener in the noise insulation device for a rail of the second embodiment.

[Fig. 10] Fig. 10 is a cross section showing a reference example of the noise insulation device for a rail of the invention.

[Fig. 11] Fig. 11 is a perspective view of a fastener in the noise insulation device for a rail of the reference example.

Description of Reference Numerals and Signs

[0031]

- (1) noise insulation device for a rail
- (2) first noise insulation member
- (3) second noise insulation member
- (4) fastener
- (5) first fastening member
- (6) second fastening member
- (7) fastener
- (8) first fastening member
- (9) second fastening member
- (11) and (14) sound absorption mat

- (13) and (16) sound insulation cover
- (13a) and (16a) slope portion
- (13b) and (16b) vertical portion
- (13c) and (16c) horizontal portion
- (21) horizontal portion
- (22) rising portion
- (23) bent portion
- (24) convex portion (first convex portion)
- (25) guide portion
- (31) horizontal portion
- (32) rising portion
- (34) through-hole (first concave portion)
- (41) horizontal portion
- (42) rising portion
- (44) convex portion (second convex portion)
- (45) convex portion (first convex portion)
- (51) horizontal portion
- (52) rising portion
- (53) bent portion
- (54) through-hole (second concave portion)
- (55) through-hole (first concave portion)
- (61), (62), and (63) convex portion

Mode for Carrying Out the Invention

[0032] Hereinafter, embodiments of the invention will be described with reference to the drawings. In the following description, the terms, "top", "bottom", "right", and "left", mean the top, the bottom, the right, and the left of Fig. 1, respectively.

[0033] Fig. 1 shows a first embodiment of a noise insulation device for a rail of the invention. The noise insulation device (1) for a rail includes a first noise insulation member (2) attached to a necessary part on a surface of the rail (R) from the left (one side), a second noise insulation member (3) attached to a necessary part on the surface of the rail (R) from the right (the other side), and a fastener (7) formed of a first fastening member (8) and a second fastening member (9) used to fasten the both insulation members (2) and (3).

[0034] The noise insulation members (2) and (3) are formed, respectively, of sound absorption mats (11) and (14), damping sheets (12) and (15), and sound insulation covers (13) and (16), which are sequentially stacked in layers from the inner side.

[0035] The noise insulation members (2) and (3) are formed, respectively, of sound absorption mats (11) and (14), damping sheets (12) and (15), and sound insulation covers (13) and (16), which are sequentially stacked in layers from the inner side.

[0036] The sound absorption mats (11) and (14) are provided in parts divided, respectively, to waist sound absorption mats (11a) and (14a), each of which is bridged from a midpoint in height of a side surface of a rail waist (Rw) to a center of an upper surface of a rail bottom (Rb) in a width direction, and bottom sound absorption mats (11b) and (14b) fit to a lower surface of the rail bottom (Rb) from beneath. In the drawing, the waist sound ab-

sorption mats (11a) and (14a) are not shown in a rectangular shape in traverse section. Instead, each is shown in a shape as if portions in contact with the rail (R) were cut out from a rectangle. It should be appreciated, however, that this shape is formed because the contact portions are pressed against the rail (R) and squeezed by compression. When attached to the rail (R), a thickness of the bottom sound absorption mats (11b) and (14b) is reduced to about half the thickness in a free state.

[0037] The damping sheets (12) and (15) are formed to have the same size (area) as the sound absorption mats (11) and (14), respectively, and divided, respectively, to waist damping sheets (12a) and (15a) and bottom damping sheets (12b) and (15b).

[0038] The sound insulation covers (13) and (16) are formed, respectively, of slope portions (13a) and (16a), each of which is bridged from near an upper end in height of the side surface of the rail waist (Rw) to near a tip end of the upper surface of the rail bottom (Rb), vertical portions (13b) and (16b) extending downward, respectively, from lower ends of the slope portions (13a) and (16a) along the side surfaces of the rail bottom (Rb), and horizontal portions (13c) and (16c) extending, respectively, from lower ends of the vertical portions (13b) and (16b) along the lower surface of the rail bottom (Rb) toward a center of the rail.

[0039] A slight clearance is provided between the horizontal portions (13c) and (16c) of the sound insulation covers (13) and (16), respectively. End faces of the horizontal portions (13c) and (16c) of the sound insulation covers (13) and (16), respectively, end faces of the bottom sound absorption mats (11b) and (14b), and end faces of the bottom damping sheets (12b) and (15b) are substantially flush with one another.

[0040] In this embodiment, the first fastening member (8) is installed first from the right and subsequently the second fastening member (9) is installed from the left.

[0041] As is also shown in Fig. 2, the first fastening member (8) has a horizontal portion (41) inserted beneath the lower surface of the rail bottom (Rb) and a rising portion (42) provided so as to continue from a right end of the horizontal portion (41) and fit to the sound insulation cover (16) of the second noise insulation member (3).

[0042] The horizontal portion (41) is fit to both of the horizontal portion (13c) of the sound insulation cover (13) of the first noise insulation member (2) and the horizontal portion (16c) of the sound insulation cover (16) of the second noise insulation member (3) from beneath.

[0043] The rising portion (42) is formed of a vertical portion (42a) stacked on the vertical portion (16b) of the sound insulation cover (16) and a slope portion (42b) stacked on the slope portion (16a) of the sound insulation cover (16). An upper end position of the slope portion (42b) is set to be substantially equal to an upper end position of the waist sound absorption mat (14a) of the second noise insulation member (3). As is also shown in Fig. 3, the second fastening member (9) is formed of

a horizontal portion (51) inserted under the lower surface of the rail bottom (Rb) and a rising portion (52) provided so as to continue from a right end of the horizontal portion (51) and fit to the sound insulation cover (13) of the first noise insulation member (2).

[0044] The horizontal portion (51) is stacked on the horizontal portion (41) of the first fastening member (8) from beneath. The rising portion (52) is formed of a vertical portion (52a) stacked on the vertical portion (13b) of the sound insulation cover (13) and a slope portion (52b) stacked on the slope portion (13a) of the sound insulation cover (13). An upper end position of the slope portion (52b) is set to be substantially equal to an upper end position of the waist sound absorption mat (11a) of the first noise insulation member (2).

[0045] The second fastening member (9) is provided with a bent portion (53) formed at a right end (end on the opposite side to the rising portion) of the horizontal portion (51) in abutment with the vertical portion (42a) of the rising portion (42) of the first fastening member (8) from the outer side. An upper end of the bent portion (53) is formed so as to bend outward. An upper end position of the bent portion (53) is set to be as high as or lower than the rail bottom (Rb). Because the upper end position of the bent portion (53) is set to be as high as or lower than the rail bottom (Rb), it is easy to move the second fastening member (9) to the right (inner side) of the rail (R) when installed from the left of Fig. 1. An installation work can be thus performed easily.

[0046] A narrow rectangular convex portion (second convex portion) (44) protruding in a horizontal direction is provided at a left end of the horizontal portion (41) of the first fastening member (8). A rectangular through-hole (second concave portion) (54) to be fit together with the convex portion (44) of the first fastening member (8) is provided at a lower end of the vertical portion (52a) of the second fastening member (9).

[0047] A substantially semi-circular convex portion (first convex portion) (45) is provided to the vertical portion (42a) of the rising portion (42) of the first fastening member (8). A circular through-hole (first concave portion) (55) to be fit together with the substantially semi-circular convex portion (45) is provided to the bent portion (53) of the second fastening member (9). In this manner, the first fastening member (8) and the second fastening member (9) are fit together in a re-attachable manner by fitting the two concave portions (44) and (45) together with the two through-holes (54) and (55), respectively.

[0048] A rubber cushion (46) extending across and in abutment with the horizontal portions (13c) and (16c) of the sound insulation covers (13) and (16) of the noise insulation members (2) and (3), respectively, is provided to the horizontal portion (41) of the first fastening member (8). Also, a rubber cushion (47) in abutment with an upper part of the slope portion (16a) of the sound insulation cover (16) of the second noise insulation member (3) is provided to the slope portion (42b) of the rising portion (42) of the first fastening member (8). A rubber cushion

(57) in abutment with an upper part of the slope portion (13a) of the sound insulation cover (13) of the first noise insulation member (2) is provided to the slope portion (52b) of the rising portion (52) of the second fastening member (9).

[0049] The damping sheets (12) and (15) are formed, respectively, of damping resin layers (17) and (19) laminated to the back surfaces of the sound insulation covers (13) and (16), respectively, and 0.27-mm-thick steel plates (18) and (20) as constrained layers stacked on the surfaces of the sound absorption mats (11) and (14), respectively, and laminated to the damping resin layers (17) and (19), respectively.

[0050] According to the noise insulation device (1) for a rail of the first embodiment, the first fastening member (8) and the second fastening member (9) to fasten the noise insulation members (2) and (3) are fit together and thereby connected to each other. Accordingly, no tool is required for bolt fixation or screw fixation, which can in turn make works less tedious and less complex. In addition, the bent portion (53) of the second fastening member (9) prevents not only leftward movements of the second fastening member (9) but also rightward movements of the first fastening member (8). Hence, these members are not readily come off.

[0051] In the first embodiment, the convex portion (44) in the horizontal portion (41) of the first fastening member (8) and the corresponding through-hole (54) in the vertical portion (52a) of the second fastening member (9) can be omitted. In this case, the left end face of the horizontal portion (41) of the first fastening member (8) is in abutment with the vertical portion (52a) of the second fastening member (9), and in this state, the convex portion (45) in the rising portion (42) of the first fastening member (8) is fit together with the through-hole (55) in the bent portion (53) of the second fastening member (9).

[0052] A method of attaching the noise insulation device (1) for a rail of the first embodiment to the rail (R) is shown in Fig. 4.

[0053] In order to attach the noise insulation device (1) for a rail of the first embodiment to the rail (R), as is shown in Fig. 4(a), whether the sound absorption mats (11b) and (14b) of the noise insulation members (2) and (3), respectively, are in abutment with the lower surface of the rail bottom (Rb) is confirmed first, and then the first fastening member (8) is installed by inserting the horizontal portion (41) of the first fastening member (8) beneath the lower surface of the rail bottom (Rb) from the right of the rail (R). By fitting the horizontal portion (41) of the first fastening member (8) onto the lower surface of the rail bottom (Rb), as is shown in Fig. 4(b), the first fastening member (8) is installed in substantially the same conditions when attachment is completed. Subsequently, the second fastening member (9) is installed. In this instance, the second fastening member (9) is inserted under the lower surface of the rail bottom (Rb) while leaving a clearance comparable to the height of the bent portion (53) between the both horizontal portions (41)

and (51) to prevent the bent portion (53) from interfering with the horizontal portion (41) of the first fastening member (8). Subsequently, the through-hole (second concave portion) (54) of the second fastening member (9) is fit together with the convex portion (first convex portion) (44) of the first fastening member (8). As is shown in Fig. 4(c), an intermediate portion of the bent portion (53) of the second fastening member (9) normally interferes with the right end of the horizontal portion (41) of the first fastening member (8) in this state and the both members cannot be fit together tightly. Accordingly, this is a state in which there is no clearance between the left end (end on the opposite side to the rising portion) of the horizontal portion (41) of the first fastening member (8) and the left end (end on the side of the rising portion) of the second fastening member (9) whereas there is a clearance between the right end (end on the side of the rising portion) of the horizontal portion (41) of the first fastening member (8) and the right end (end on the opposite side to the rising portion) of the second fastening member (9). Herein, a bar-like tool (60) is used and a left end (60a) of the tool (60) is given as the pivot point and a right end (60b) of the tool (60) is given as the point of effort. Then, the clearance between the right end of the horizontal portion (41) of the first fastening member (8) and the right end of the second fastening member (9) is eliminated by bringing an intermediate portion (60c) of the tool (60) in abutment with the right end (end on the side of the bent portion) of the horizontal portion (51) of the second fastening member (9) from below and applying an upward force to the right end (60b) (the point of effort). Accordingly, as is shown in Fig. 4(d), the convex portion (first convex portion) (45) of the first fastening member (8) and the through-hole (first concave portion) (55) of the second fastening member (9) are fit together and the first fastening member (8) and the second fastening member (9) are connected to each other firmly. The noise insulation device (1) for a rail can be thus attached to the rail (R) so as not to come off the rail (R).

[0054] For the purpose of preventing the fastener (7) from moving in a length direction of the rail (R), it is preferable for the noise insulation device (1) for a rail of the first embodiment to provide convex portions (61) to the sound insulation cover (13) so as to sandwich the fastener (7) from both sides of the rail (R) in the length direction as is shown in Fig. 5. The convex portions can be convex portions (61) of a half-cut semispherical shape as is shown in Fig. 6(a), convex portions (62) of a circular truncated conical shape as is shown in Fig. 6(b), or convex portions (63) of a semispherical shape as is shown in Fig. 6(c). In the case of the convex portions (61) of a half-cut semispherical shape, the cut planes are formed so as to oppose the fastener (7) as is shown in Fig. 5.

[0055] Fig. 7 is a view showing a second embodiment of the noise insulation device for a rail of the invention. The noise insulation device (1) for a rail includes a first noise insulation member (2) attached to a necessary part on the surface of the rail (R) from the left (one side), a

second noise insulation member (3) attached to a necessary part on the surface of the rail (R) from the right (the other side), and a fastener (4) formed of a first fastening member (5) and a second fastening member (6) used to fasten the both noise insulation members (2) and (3).

[0056] The noise insulation members (2) and (3) are the same as their respective counterparts in the first embodiment above and a description is omitted herein by labeling the same reference numerals as those of the first embodiment above.

[0057] As is also shown in Fig. 8, the first fastening member (5) has a horizontal portion (21) inserted beneath the lower surface of the rail bottom (Rb) and a rising portion (22) provided so as to continue from a left end of the horizontal portion (21) and fit to the slope portion (13a) of the sound insulation cover (13) of the first noise insulation member (2). The horizontal portion (21) is fit to both of the horizontal portion (13c) of the sound insulation cover (13) of the first noise insulation member (2) and the horizontal portion (16c) of the sound insulation cover (16) of the second noise insulation member (3) from beneath. An upper end position of the rising portion (22) is set to be substantially equal to an upper end position of the waist sound absorption mat (11a) of the first noise insulation member (2).

[0058] As is also shown in Fig. 9, the second fastening member (6) has a horizontal portion (31) inserted under the lower surface of the rail bottom (Rb) and a rising portion (32) provided so as to continue from a right end of the horizontal portion (31) and fit to the slope portion (16a) of the sound insulation cover (16) of the second noise insulation member (2). The horizontal portion (31) is stacked on the horizontal portion (21) of the first fastening member (5) from beneath. An upper end position of the rising portion (32) is set to be substantially equal to an upper end position of the waist sound absorption mat (14a) of the second noise insulation member (3).

[0059] The first fastening member (5) is provided with a bent portion (23) formed at the right end (end on the opposite side to the rising portion) of the horizontal portion (21) so as to restrict leftward movements (toward the rising portion) of the first fastening member (5). An upper end position of the bent portion (23) is set to be as high as or lower than the rail bottom (Rb). The first fastening member (5) is installed from the left of Fig. 7. In this instance, because the upper end position of the bent portion (23) is set to be as high as or lower than the rail bottom (Rb), it is easy to move the first fastening member (5) to the right (inner side) of the rail (R). An installation work can be thus performed easily.

[0060] A convex portion (first convex portion) (24) of a square shape and becoming lower toward the right is provided near the left end on the lower surface of the horizontal portion (21) of the first fastening member (5). A through-hole (first concave portion) (34) of a square shape to be fit together with the convex portion (24) of the first fastening member (5) is provided to the horizontal

portion (31) of the second fastening member (6). The first fastening member (5) and the second fastening member (6) are fit together in a re-attachable manner by fitting the convex portion (24) and the through-hole (34) together.

[0061] A guide portion (25) is provided at the right end of the horizontal portion (21) of the first fastening member (5) along both edges of the horizontal portion (21). The guide portion (25) is formed of opposing walls (25a) formed so as to protrude downward from the both edges of the horizontal portion (21). An interval between the opposing walls (25a) is set to be substantially equal to the horizontal portion (31) of the second fastening member (6). Owing to this configuration, when the horizontal portion (21) of the first fastening member (5) and the horizontal portion (31) of the second fastening member (6) are stacked, the horizontal portion (31) of the second fastening member (6) is guided by the guide portion (25) of the first fastening member (5), so that displacement is prevented. After the horizontal portions (21) and (31) are stacked, movements of the horizontal portion (31) of the second fastening member (6) in the rail length direction are restricted.

[0062] A rubber cushion (26) extending across and in abutment with the horizontal portions (13c) and (16c) of the sound insulation covers (13) and (16) of the noise insulation members (2) and (3), respectively, is provided to the horizontal portion (21) of the first fastening member (5). Also, a rubber cushion (27) in abutment with an upper part of the slope portion (13a) of the sound insulation cover (13) of the first noise insulation member (2) is provided to the rising portion (22) of the first fastening member (5). A rubber cushion (37) in abutment with an upper part of the slope portion (16a) of the sound insulation cover (16) of the second noise insulation member (2) is provided to the rising portion (32) of the second fastening member (6).

[0063] According to the noise insulation device (1) for a rail of the second embodiment, the first fastening member (5) and the second fastening member (6) to fasten the noise insulation members (2) and (3) are fit together and thereby connected to each other. Accordingly, no tool is required for bolt fixation or screw fixation, which can in turn make works less tedious and less complex. It should be noted that the first fastening member (5) and the second fastening member (6) are fit together in a re-attachable manner not necessarily by fitting the convex portion (24) of the horizontal portion (21) of the first fastening member (5) and the through-hole (concave portion) (34) of the horizontal portion (31) of the second fastening member (6) together. It may be configured in such a manner that a concave portion is provided to the horizontal portion (21) of the first fastening member (5) and a convex portion is provided to the upper surface of the horizontal portion (31) of the second fastening member (6). Alternatively, the numbers and shapes of the convex portion and the through-hole (concave portion) may be changed.

[0064] The bent portion (23) and the guide portion (25) are provided to the first fastening member (5). However, a guide portion may be provided to the second fastening member (6) by omitting the guide portion (25) of the first fastening member (5) or a bent portion may be provided also to the second fastening member (6) by omitting the guide portion (25) of the first fastening member (5). Alternatively, it may be configured in such a manner that the first fastening member (5) and the second fastening member (6) are connected by merely fitting the guide portion (25) of the first fastening member (5) and the horizontal portion (31) of the second fastening member (6) together without fitting the convex portion (24) of the horizontal portion (21) of the first fastening member (5) and the through-hole (concave portion) (34) of the horizontal portion (31) of the second fastening member (6) together.

[0065] In the description above, the sound absorption mats (11) and (14) may be formed of the waist sound absorption mats (11a) and (14a) alone, respectively. In this case, the sound insulation cover may be formed in the shape of a flat plate bridged between the upper end of the side surface of the rail waist and the tip end of the upper surface of the rail bottom.

[0066] In the above description, the damping sheets (12) and (15) enhance the noise insulation effect by suppressing vibrations of the sound insulation covers (13) and (16), respectively. It should be appreciated, however, that excellent noise insulation performance can be achieved by omitting the damping sheets (12) and (15) and instead by using sound absorption mats (11) and (14), which are provided in parts divided to waist sound absorption mats (11a) and (14a) and bottom sound absorption mats (11b) and (14b), respectively, and sound insulation covers (13) and (16) covering the sound absorption mats (11) and (14), respectively.

[0067] Fig. 10 shows a reference example when the noise insulation devices for a rail of the embodiments above is simplified. A noise insulation device (10) for a rail includes a first noise insulation member (2) attached to a necessary part on the surface of a rail (R) from the left (one side), a second noise insulation member (3) attached to a necessary part on the surface of the rail (R) from the right (the other side), and a fastener (70) used to fasten the both noise insulation members (2) and (3).

[0068] The noise insulation members (2) and (3) are the same as their respective counterparts of the embodiments above and a description is omitted herein by labeling the same reference numerals as those of the embodiments above.

[0069] As is also shown in Fig. 11, the fastener (70) has a horizontal portion (71) inserted beneath the lower surface of the rail bottom (Rb), a first rising portion (72) provided so as to continue from a left end of the horizontal portion (71) and fit to the slope portion (13a) of the sound insulation cover (13) of the first noise insulation member (2), and a second rising portion (73) provided so as to continue from a right end of the horizontal portion (71) and fit to the vertical portion (16b) of the sound insulation

cover (16) of the second noise insulation member (3).

[0070] The horizontal portion (71) is fit to both of the horizontal portion (13c) of the sound insulation cover (13) of the first noise insulation member (2) and the horizontal portion (16c) of the sound insulation cover (16) of the second noise insulation member (3) from beneath.

[0071] An upper end position of the first rising portion (72) is set to be substantially equal to an upper end position of the waist sound absorption mat (11a) of the first noise insulation member (2) and an upper end position of the second rising portion (73) is set to be as high as or lower than the rail bottom (Rb). The fastener (70) is installed from the left of Fig. 10. In this instance, because the upper end position of the second rising portion (73) is set to be as high as or lower than the rail bottom (Rb), it is easy to move the fastener (70) to the right (inner side) of the rail (R). An installation work can be thus performed easily.

[0072] The horizontal portion (71) is provided with a rubber cushion (74) extending across and in abutment with the horizontal portion (13c) and (16c) of the sound insulation covers (13) and (16) of the noise insulation members (2) and (3), respectively. The first rising portion (72) is provided with a rubber cushion (75) in abutment with an upper part of the slope portion (13a) of the sound insulation cover (13) of the first noise insulation member (2).

[0073] According to the noise insulation device (10) for a rail of this reference example, in contrast to the first and second embodiments above where two fastening members (8) and (9) and two fastening members (5) and (6) are required, respectively, both of the noise insulation members (2) and (3) can be fastened by the single fastener (70). In this instance, no tool is required for bolt fixation or screw fixation, which can in turn make works less tedious and less complex. Also, it is not structured so as to fasten the fastener (70) by bolts on a side in the lower surface of the rail bottom. Hence, a portion overhanging from the rail (R) becomes extremely small and does not interfere with rail maintenance.

Industrial Applicability

[0074] According to the noise insulation device for a rail of the invention, sounds generated at the rail are reduced and, moreover, works can be less tedious and less complex. Hence, contributions can be made to railroad noise-reduction.

Claims

1. A noise insulation device for a rail, including a first noise insulation member having a sound absorption mat and a sound insulation cover and attached to a necessary part on a rail surface from one side, a second noise insulation member having a sound absorption mat and a sound insulation cover and at-

tached to a necessary part on the rail surface from the other side, and a fastener used to fasten the both noise insulation members, the noise insulation device for a rail being **characterized in that:**

the fastener is formed of a first fastening member and a second fastening member;
the first fastening member has a horizontal portion inserted beneath a lower surface of a rail bottom and a rising portion provided so as to continue from an end of the horizontal portion and fit to the sound insulation cover of one of the noise insulation members;
the second fastening member has a horizontal portion inserted beneath the horizontal portion of the first fastening member and a rising portion provided so as to continue from an end of the horizontal portion and fit to the sound insulation cover of the other one of the noise insulation members; and
at least one convex portion is provided to one of the first and second fastening members and a concave portion to be fit together with the convex portion is provided to the other one of the fastening members, so that the first fastening member and the second fastening member are fit together in a re-attachable manner with the respective horizontal portions being stacked.

2. The noise insulation device for a rail according to claim 1, **characterized in that:**

at least one of the first and second fastening members is provided with a bent portion formed at an end of the horizontal portion on an opposite side to the rising portion so as to restrict a movement of the fastening member toward the rising portion.

3. The noise insulation device for a rail according to claim 2, **characterized in that:**

the bent portion is provided to the second fastening member and brought into abutment with the rising portion of the first fastening member from an outer side.

4. The noise insulation device for a rail according to claim 3, **characterized in that:**

the at least one convex portion includes a first convex portion provided on an outer surface of the rising portion of the first fastening member; and
a first concave portion to be fit together with the first convex portion is provided to the bent portion of the second fastening member.

5. The noise insulation device for a rail according to claim 4, **characterized in that:**

the at least one convex portion includes a second convex portion provided so as to protrude in a horizontal direction from the end of the horizontal portion of the first fastening member on the opposite side to the rising portion; and
a second concave portion to be fit together with the second convex portion is provided at a lower end of the rising portion of the second fastening member.

6. The noise insulation device for a rail according to claim 1 or 2, **characterized in that:**

the at least one convex portion includes a first convex portion provided to the horizontal portion of one of the first and second fastening members; and
a first concave portion to be fit together with the first convex portion is provided to the horizontal portion of the other one of the fastening members.

7. The noise insulation device for a rail according to claim 6, **characterized in that:**

the horizontal portion of one of the first and second fastening members is provided with a guide portion that guides the horizontal portion of the other one of the fastening members when the horizontal portion of the other one of the fastening members is stacked thereon and also restricts a movement of the horizontal portion of the other one of the fastening members in a rail length direction after the horizontal portions are stacked.

8. The noise insulation device for a rail according to any of claims 1 through 7, **characterized in that:**

the sound insulation cover is formed in a shape of a flat plate bridged between an upper end of a side surface of a rail waist and a tip end of an upper surface of the rail bottom.

9. The noise insulation device for a rail according to any of claims 1 through 7, **characterized in that:**

the sound insulation cover has a slope portion extending from an upper end of a side surface of a rail waist to a tip end of an upper surface of the rail bottom, a vertical portion extending from a lower end of the slope portion along a side surface of the rail bottom, and a horizontal portion extending from a lower end of the vertical portion along a lower surface of the rail bottom;

and
the sound absorption mat is provided to both of
the slope portion and the horizontal portion.

10. The noise insulation device for a rail according to claim 9, **characterized in that:**

the vertical portion of the sound insulation cover
is provided with a convex portion that prevents
displacement of the respective fastening mem-
bers in a rail direction.

11. A method of attaching the noise insulation device for a rail set forth in claim 5 to a rail, **characterized by** comprising:

a step of installing the first fastening member by
inserting the horizontal portion of the first fast-
ening member beneath the lower surface of the
rail bottom from one side of the rail;
a step of installing the second fastening member
by inserting the horizontal portion of the second
fastening member beneath the horizontal por-
tion of the first fastening member from the other
side of the rail for the second concave portion
of the second fastening member and the second
convex portion of the first fastening member to
be fit together in such a manner that there is no
clearance between an end of the horizontal por-
tion of the first fastening member on the opposite
side to the rising portion and an end of the sec-
ond fastening member on a side of the rising
portion whereas there is a clearance between
an end of the horizontal portion of the first fast-
ening member on the side of the rising portion
and an end of the horizontal portion of the sec-
ond fastening member on a side of the bent por-
tion; and
a step of eliminating the clearance between the
end of the horizontal portion of the first fastening
member on the side of the rising portion and the
end of the second fastening member on the side
of the bent portion using a bar-like tool given that
one end of the tool is a pivot point and the other
end of the tool is a point of effort by bringing an
intermediate portion of the tool in abutment with
the end of the horizontal portion of the second
fastening member on the side of the bent portion
from below and applying an upward force to the
point of effort.

55

Fig. 1

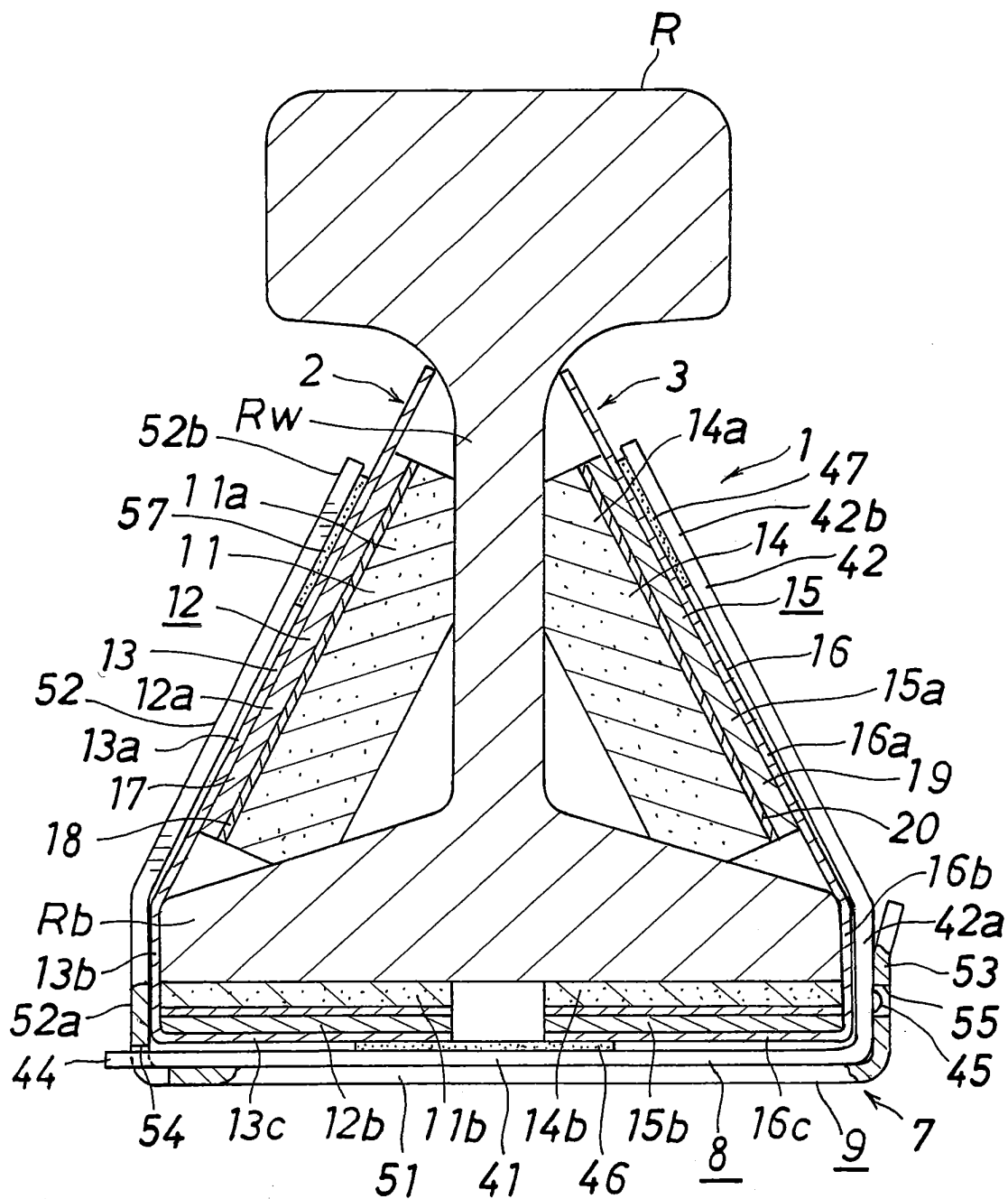


Fig. 2

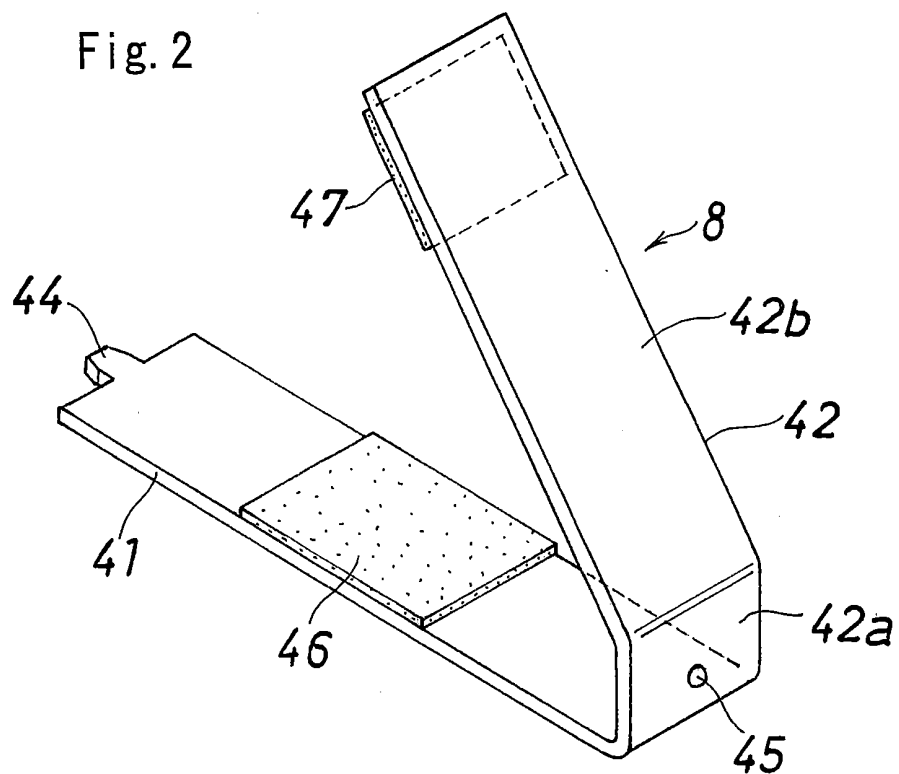


Fig. 3

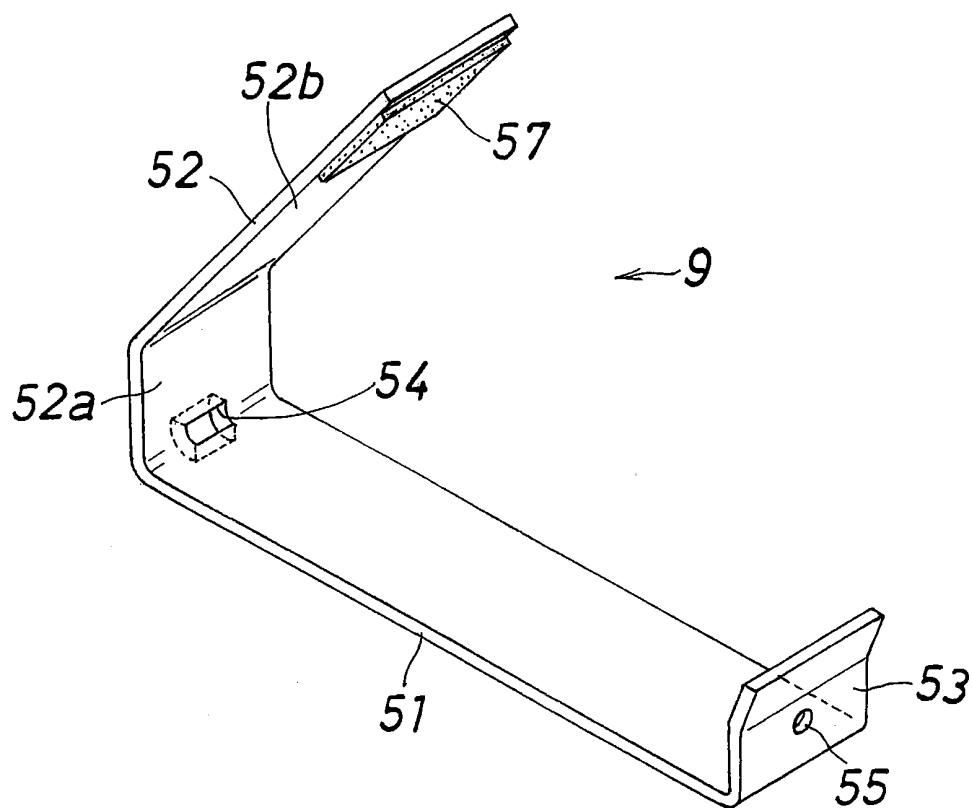


Fig. 4

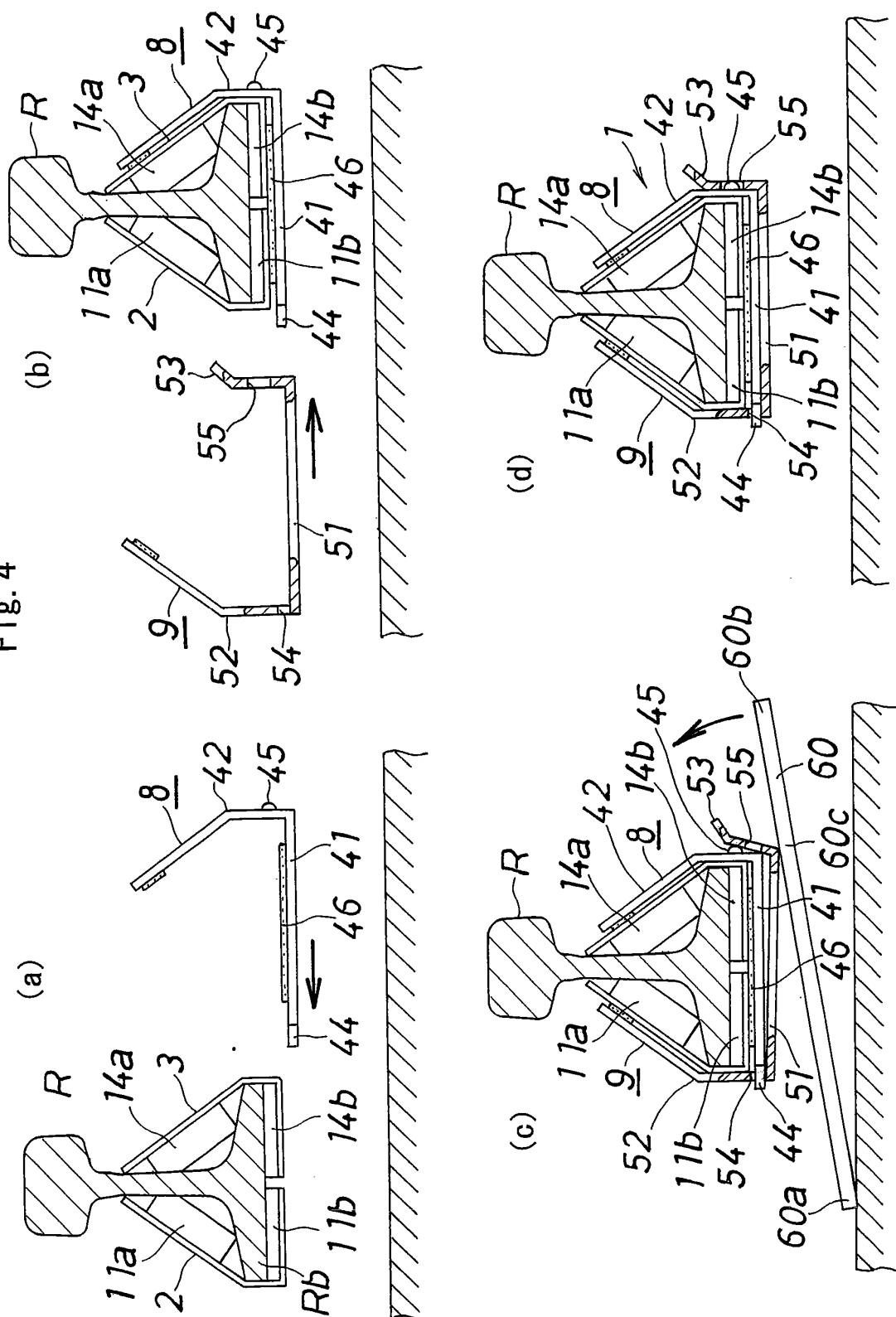


Fig. 5

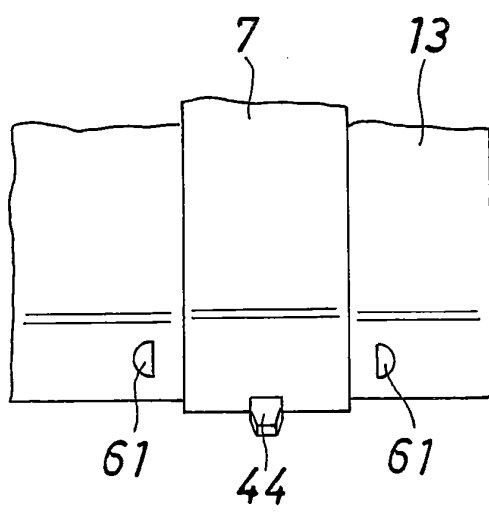


Fig. 6

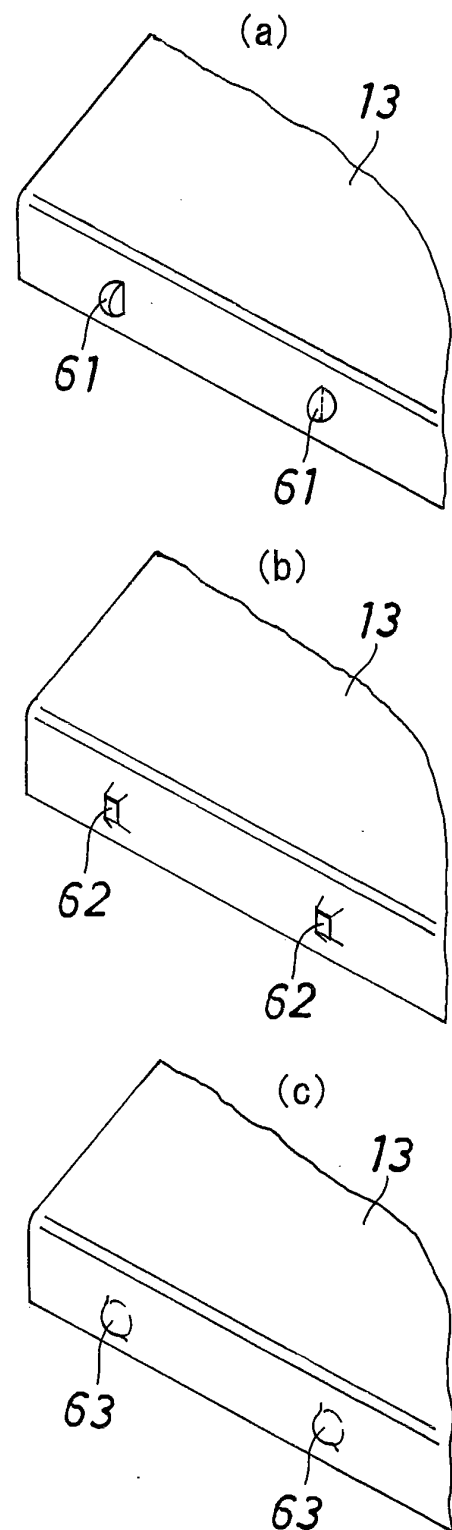


Fig. 7

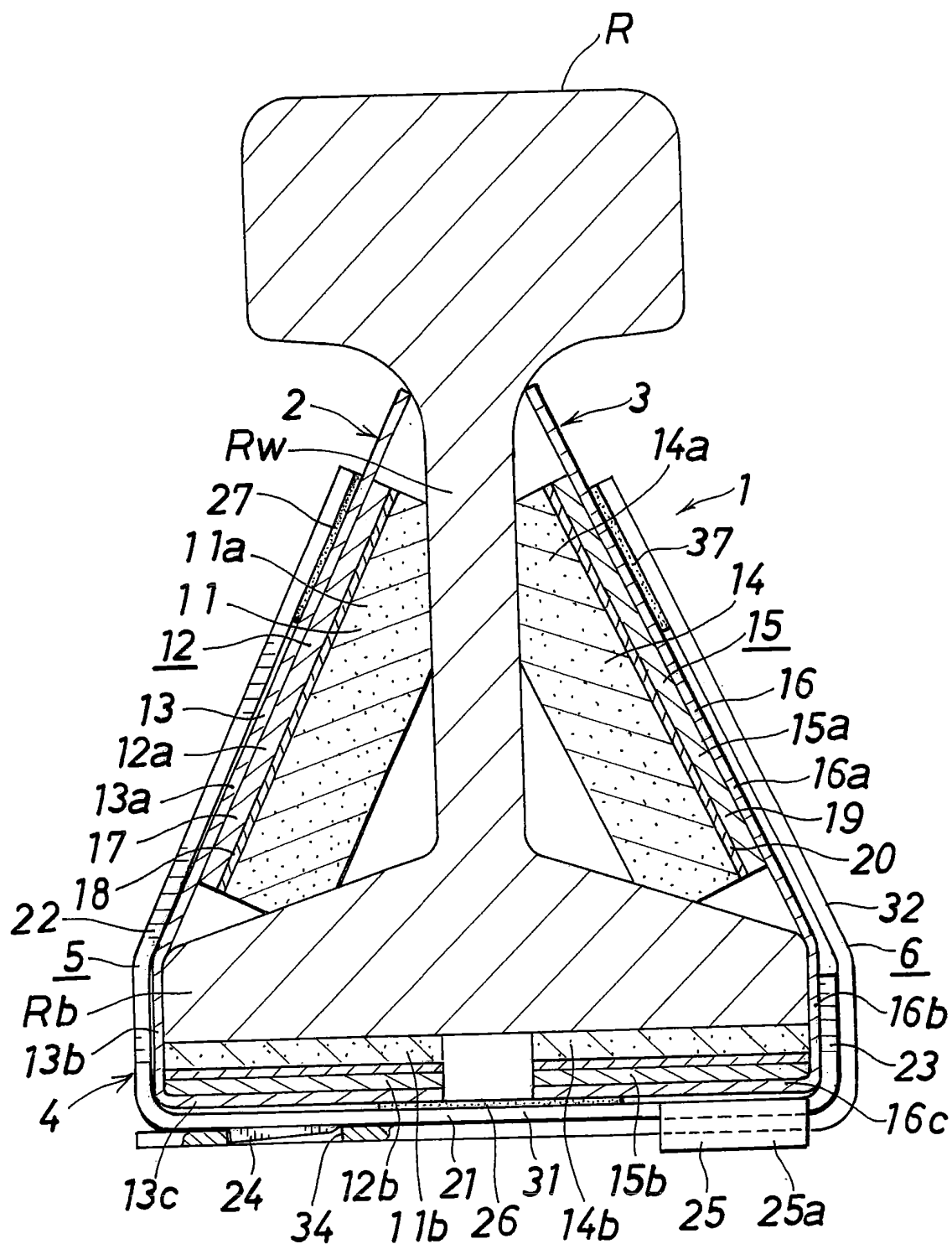


Fig. 8

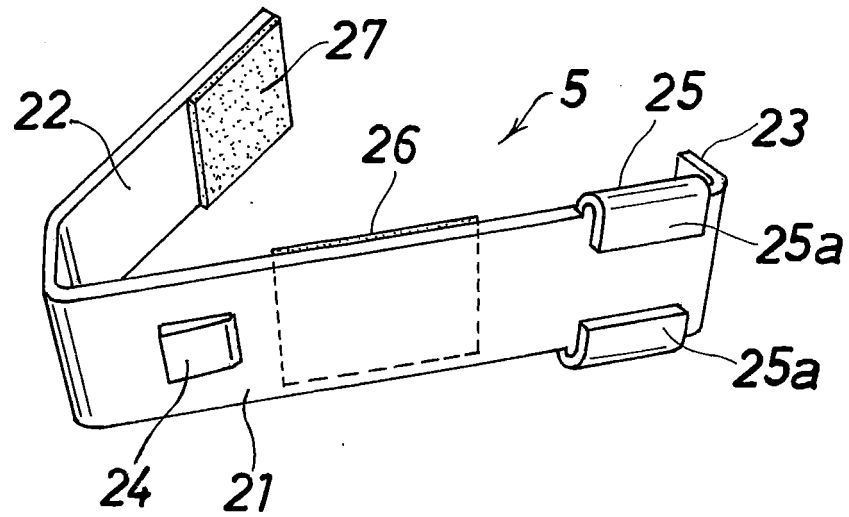


Fig. 9

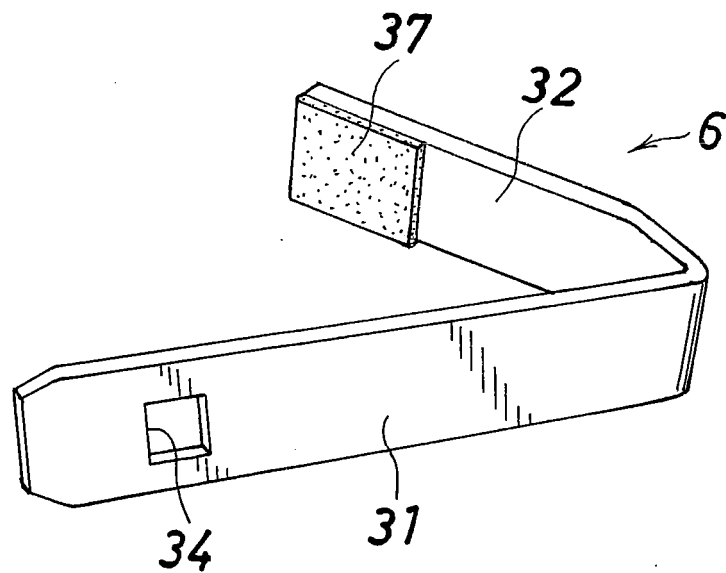


Fig. 10

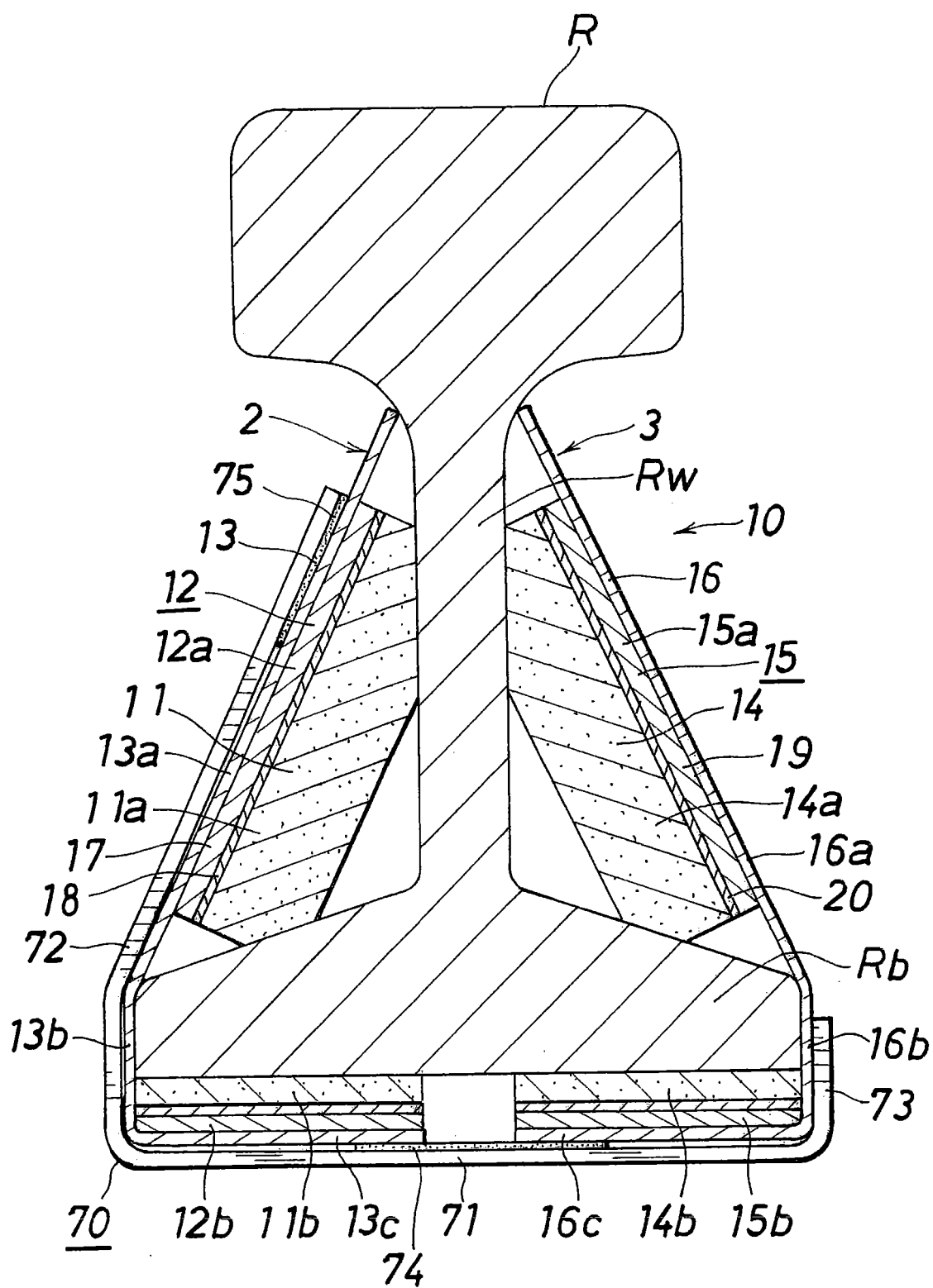
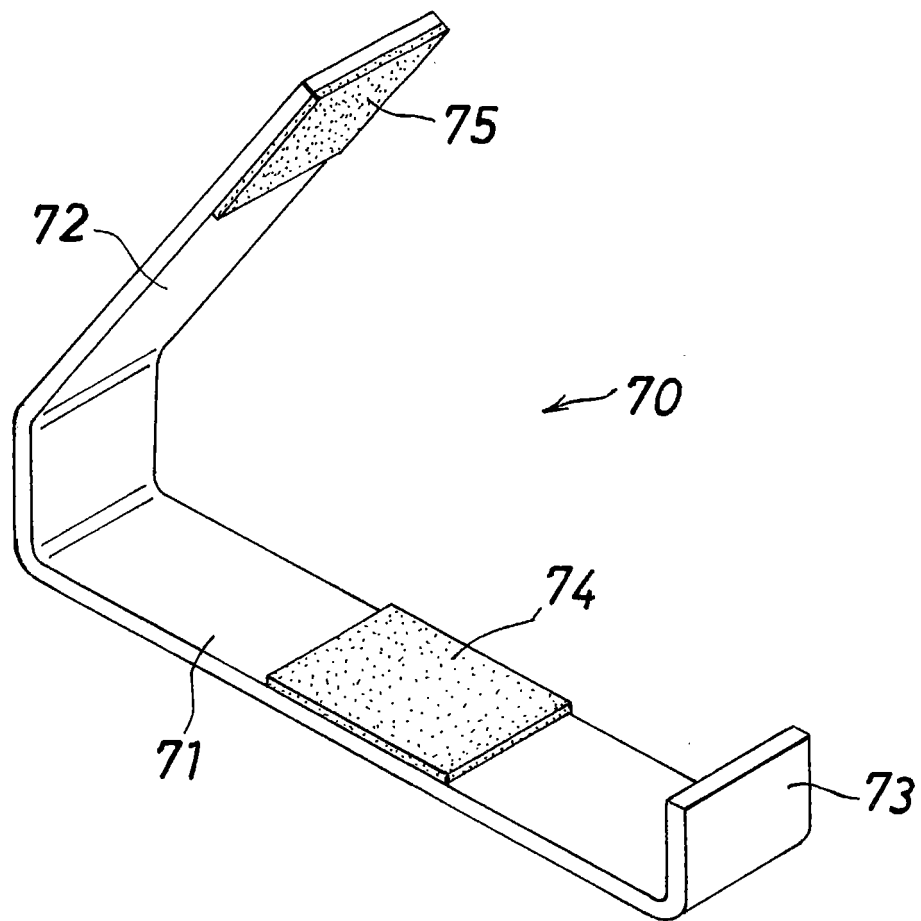


Fig. 11



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2012/075154

A. CLASSIFICATION OF SUBJECT MATTER

E01B19/00 (2006.01) i

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)

E01B19/00

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

Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2012

Kokai Jitsuyo Shinan Koho 1971-2012 Toroku Jitsuyo Shinan Koho 1994-2012

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y A	JP 2006-002442 A (Railway Technical Research Institute et al.), 05 January 2006 (05.01.2006), paragraphs [0030] to [0051]; fig. 1 to 8 (Family: none)	1, 6-10 2-5
Y A	JP 10-152801 A (Yugen Kaisha Koshinsha), 09 June 1998 (09.06.1998), paragraphs [0039] to [0043]; fig. 6 to 7 & US 6402044 B1	1, 6-10 2-5
Y	JP 2008-095408 A (SWCC Showa Device Technology Co., Ltd. et al.), 24 April 2008 (24.04.2008), paragraphs [0017] to [0023]; fig. 1 to 2 (Family: none)	8-10

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

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"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
20 December, 2012 (20.12.12)Date of mailing of the international search report
08 January, 2013 (08.01.13)Name and mailing address of the ISA/
Japanese Patent Office

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Facsimile No.

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Form PCT/ISA/210 (second sheet) (July 2009)

REFERENCES CITED IN THE DESCRIPTION

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