

DESCRIPTION

Title of Invention: AXLE BOX SUSPENSION OF RAILCAR

Technical Field

[0001] The present invention relates to an axle box suspension of a railcar, the axle box suspension coupling an axle box to a bogie frame.

Background Art

[0002] In a railcar bogie, an axle box is supported by an axle box suspension so as to be displaceable relative to a bogie frame. There are various types of axle box suspensions. For example, in an axle beam type axle box suspension disclosed in PTL 1, an axle spring constituted by a coil spring is interposed between an axle box and a bogie frame, and a tip end portion of an axle beam extending from the axle box in a car longitudinal direction is supported by receiving seats of the bogie frame. A tubular portion is formed at the tip end portion of the axle beam, and a core rod is inserted into the tubular portion through a rubber bushing. A pair of protruding portions formed on both respective car width direction side surfaces of the core rod are fitted into fitting grooves of the receiving seats of the bogie frame from below. Projecting portions of lids each having a convex shape are fitted into the fitting grooves so as to support the protruding portions from below, and base portions of the lids are arranged so as to be opposed to lower surfaces of the receiving seats. The base portions are fixed to the receiving seats by bolts.

Citation List

Patent Literature

[0003] PTL 1: Japanese Laid-Open Patent Application Publication No. 2015-107773

Summary of Invention

Technical Problem

[0004] According to the configuration of PTL 1, both the protruding portion of the core rod and the projecting portion of the lid are fitted into the fitting groove of the bogie frame. Therefore, the position of a circular-arc surface constituting an inner surface of the fitting groove and contacting the protruding portion of the core rod and the position of a flat surface constituting the inner surface of the fitting groove and contacting the projecting portion of the lid need to coincide with each other in the car longitudinal direction. Therefore, high machining accuracy is required when forming the above surfaces constituting the inner surface of the fitting groove through separate steps.

[0005] An object of the present invention is to provide an axle box suspension which relaxes the requirement of machining accuracy of a receiving seat and a lid, and therefore,

improves productivity.

Solution to Problem

[0006] An axle box suspension of a railcar according to one aspect of the present invention is an axle box suspension of a railcar, the axle box suspension coupling an axle box to a bogie frame. The axle box suspension includes: a coupler extending from the axle box in a car longitudinal direction and including a tubular portion at a tip end portion of the coupler, the tubular portion being open toward both sides in a car width direction, the coupler coupling the axle box and the bogie frame; a core rod inserted into an internal space of the tubular portion, a pair of protruding portions being provided at both respective sides of the core rod in the car width direction; an elastic bushing interposed between the tubular portion and the core rod; a pair of receiving seats provided at the bogie frame and including a pair of recess portions and a pair of groove portions formed by depressing parts of bottom surfaces of the recess portions; a pair of lids supporting the pair of protruding portions fitted into the pair of groove portions, the pair of lids being fitted into the pair of recess portions; and fasteners fixing the lids to the receiving seats.

[0007] According to the above configuration, a width of the recess portion of the receiving seat at which the lid is positioned is larger than a width of the groove portion at which the protruding portion of the core rod is positioned, and therefore, the position of the recess portion and the position of the groove portion are not required to coincide with each other. Therefore, one of the recess portion and the groove portion does not have to be machined in accordance with the width of the other of the recess portion and the groove portion, and thus, the requirement of the machining accuracy regarding the relative positional relation between the recess portion and the groove portion can be significantly relaxed.

Advantageous Effects of Invention

[0008] According to the present invention, the requirement of the machining accuracy of the receiving seat can be significantly relaxed, and therefore, the productivity improves.

Brief Description of Drawings

[0009] Fig. 1 is a side view of an axle box suspension of a railcar according to an embodiment.

Fig. 2 is a sectional view taken along line II-II of Fig. 1.

Fig. 3 is a major-components enlarged view in which a receiving seat and a lid in Fig. 1 are omitted.

Fig. 4 is a major-components enlarged view showing work of fastening bolts of Fig. 1.

Description of Embodiments

[0010] Hereinafter, an embodiment will be described with reference to the drawings.

[0011] As shown in Fig. 1, an axle box suspension 1 of a railcar of the embodiment is an axle beam type axle box suspension coupling an axle box 4 to a bogie frame 5. The axle box suspension 1 includes the axle box 4 accommodating a bearing 3 rotatably supporting an axle 2. An axle spring 6 constituted by a coil spring is interposed between the axle box 4 and a side sill 5a of the bogie frame 5, the side sill 5a being located above the axle box 4. The axle box 4 is coupled to the side sill 5a by a coupling mechanism 7. The coupling mechanism 7 includes an axle beam 8 extending integrally from the axle box 4 toward a bogie middle side in a car longitudinal direction (car traveling direction). A tubular portion 9 is provided at a tip end portion of the axle beam 8. The tubular portion 9 includes an inner peripheral surface having a cylindrical shape and is open toward both sides in a car width direction. A core rod 10 is inserted into an internal space of the tubular portion 9 through an elastic bushing 11.

[0012] As shown in Figs. 2 and 3, the core rod 10 includes a columnar portion 10a, a pair of conical flange portions 10b, and protruding portions 10c. The flange portions 10b are provided at both respective car width direction sides of the columnar portion 10a. The protruding portions 10c project outward in the car width direction from both respective side surfaces of the flange portions 10b. Each of upper surfaces 10d of the protruding portions 10c has a semi-circular surface. Lower surfaces 10e of the protruding portions 10c are flat surfaces. The lower surface 10e of the protruding portion 10c is located lower than a center C of of the circular-arc shape of the upper surface 10d of the protruding portions 10c.

[0013] In the protruding portion 10c, a width of the lower surface 10e in the car longitudinal direction is smaller than a maximum width of the upper surface 10d in the car longitudinal direction. A portion 10f which is part of an outer peripheral surface of the protruding portion 10c and connects the upper surface 10d and the lower surface 10e to each other has such a shape that a width of the portion 10f in the car longitudinal direction decreases as the portion 10f extends downward. For example, the portion 10f may be a circular-arc surface that is concentric with the circular-arc upper surface 10d or may be a tapered surface.

[0014] The elastic bushing 11 is, for example, a rubber bushing. The elastic bushing 11 includes a cylindrical portion 11a and a pair of conical flange portions 11b provided at both respective sides of the cylindrical portion 11a in the car width direction. The elastic bushing 11 is externally fitted to the core rod 10. The cylindrical portion 11a of the elastic bushing 11 contacts the columnar portion 10a of the core rod 10. The flange portions 11b of the elastic bushing 11 contacts the respective flange portions 10b of the core rod 10.

[0015] As shown in Fig. 3, the tubular portion 9 of the axle beam 8 is divided into: a first semi-tubular portion 12 provided integrally with the axle beam 8; and a second semi-tubular portion 13 formed separately from the first semi-tubular portion 12. Inner peripheral surfaces of the first semi-tubular portion 12 and the second semi-tubular portion 13 are formed so as to correspond to outer peripheral surfaces of the cylindrical portion 11a and flange portions 11b of the elastic bushing 11. The first semi-tubular portion 12 and the second semi-tubular portion 13 sandwich the core rod 10 through the elastic bushing 11 and are fixed to each other by screw rods 14 and nuts 15. By the elasticity of the elastic bushing 11, the tubular portion 9 is allowed to be displaced relative to the core rod 10 in front, rear, left, right, upper, and lower directions.

[0016] As shown in Figs. 1, 2, and 4, the side sill 5a is provided with a pair of receiving seats 16 projecting downward. Each of the pair of receiving seats 16 includes a recess portion 17 and a groove portion 18. The recess portion 17 is formed by depressing a lower end surface 16a of the receiving seat 16 upward and is open toward both sides in the car width direction and a lower side. The recess portion 17 includes a bottom surface 17a (a ceiling surface of a space where a lid 19 is arranged) and a pair of side surfaces 17b extending downward from both respective car longitudinal direction ends of the bottom surface 17a. Each of the bottom surface 17a and the side surfaces 17b is a flat surface obtained by flattening machining. In the present embodiment, the bottom surface 17a is a horizontal surface, and the side surfaces 17b are vertical surfaces. However, the shapes of the surfaces 17a and 17b are not limited to these. For example, the side surfaces 17b may be oblique surfaces or curved surfaces.

[0017] The groove portion 18 is formed by depressing part of the bottom surface 17a of the recess portion 17 upward and is open toward both sides in the car width direction and a lower side. A width W2 of the groove portion 18 in the car longitudinal direction is smaller than a width W1 of the recess portion 17 in the car longitudinal direction. The protruding portion 10c of the core rod 10 is fitted into the groove portion 18 from below. In this state, the lid 19 is accommodated in the recess portion 17 so as to contact the lower surface 10e of the protruding portion 10c of the core rod 10. The lid 19 is fixed to the receiving seat 16 from below by bolts B (fasteners), and the protruding portion 10c is supported by the lid 19 from below. In the present embodiment, a direction in which the bolt B is fastened is a vertical direction.

[0018] As shown in Figs. 1 and 4, regarding the direction in which the bolt B is fastened, a depth of the groove portion 18 is smaller than a height of the protruding portion 10c. To be specific, with the protruding portion 10c fitted into the groove portion 18, the protruding portion 10c projects toward the lid 19 (lower side) beyond the bottom surface 17a of the recess portion 17. The groove portion 18 includes a circular-arc surface 18a formed by curved surface

machining. The circular-arc surface 18a has a semi-circular shape that is convex upward along the upper surface 10d (circular-arc surface) of the protruding portion 10c. To be specific, each of a contact surface of the protruding portion 10c and a contact surface of the groove portion 18 which surfaces contact each other is a circular-arc surface.

[0019] The groove portion 18 further includes a pair of tapered surfaces 18b. The pair of tapered surfaces 18b are continuous with both respective car longitudinal direction lower ends of the circular-arc surface 18a. Further, the pair of tapered surfaces 18b are inclined so as to be away from each other as they extend downward. Lower ends of the tapered surfaces 18b are continuous with the bottom surface 17a of the recess portion 17. Internal screw holes 20 are formed on the bottom surface 17a of the recess portion 17 of the receiving seat 16 so as to be located at both respective sides of the groove portion 18.

[0020] The lid 19 includes at least surfaces opposed to the lower surface 10e of the protruding portion 10c, the bottom surface 17a of the recess portion 17, and the side surfaces 17b of the recess portion 17. In the lid 19, the surface opposed to the bottom surface 17a of the recess portion 17 and the surface opposed to the lower surface 10e of the protruding portion 10c are continuously formed on the same plane. To be specific, a flat upper surface of the lid 19 is a surface opposed to the lower surface 10e of the protruding portion 10c and the bottom surface 17a of the recess portion 17. As one example, the lid 19 has a rectangular solid shape. However, the shape of the lid 19 is not limited to this and may be, for example, a trapezoidal shape in a side surface.

[0021] Through holes 19a extending in the vertical direction are formed on the lid 19 at positions corresponding to the internal screw holes 20. With the protruding portion 10c fitted into the groove portion 18, the lid 19 is fitted into the recess portion 17, and the upper surface of the lid 19 contacts the lower surface 10e of the protruding portion 10c. The bolts B are fastened to the internal screw holes 20 through the through holes 19a of the lid 19.

[0022] As shown in Fig. 4, when fixing the lid 19 to the receiving seat 16 by the bolts B, the lid 19 first contacts the lower surface 10e of the protruding portion 10c before the bottom surface 17a of the recess portion 17. To be specific, at the moment when the lid 19 is fitted into the recess portion 17 from below, and the upper surface of the lid 19 starts contacting the lower surface 10e of the protruding portion 10c, a gap having a distance L exists between the lid 19 and the bottom surface 17a of the recess portion 17. In this state, by further fastening the bolts B, the lid 19 presses the protruding portion 10c upward, and therefore, the protruding portion 10c is strongly held between the groove portion 18 and the lid 19.

[0023] To be specific, the pressing force generated by the lid 19 when fastening the bolts B

acts on the lower surface 10e of the protruding portion 10c more preferentially than on the receiving seat 16. Then, contact pressure between a lower surface of the groove portion 18 and a top surface of the protruding portion 10c is higher than contact pressure between a side surface of the groove portion 18b and a side surface of the protruding portion 10c. Therefore, load acting on the core rod 10 in the car width direction can be received by frictional force between the groove portion 18 and the protruding portion 10c. Since the shape of the groove portion 18 is a circular-arc shape, the generation of the stress concentration can be suppressed even at a load path of the bogie frame 5.

[0024] According to the above-described configuration, the width W1 of the recess portion 17 of the receiving seat 16 at which the lid 19 is positioned is larger than the width W2 of the groove portion 18 at which the protruding portion 10c of the core rod 10 is positioned, and therefore, the position of the recess portion 17 in the car longitudinal direction and the position of the groove portion 18 in the car longitudinal direction are not required to surely coincide with each other. On this account, the requirement of the machining accuracy regarding the relative positional relation between the recess portion 17 and the groove portion 18 can be significantly relaxed. Especially, in the present embodiment, since the groove portion 18 has a circular-arc surface, and the recess portion 17 has a flat surface, these surfaces are formed through separate steps. However, since the requirement of the positional accuracy between the machining of the circular-arc surface and the machining of the flat surface is relaxed, the effect of facilitating the machining becomes significant.

[0025] With the protruding portion 10c fitted into the groove portion 18, the protruding portion 10c projects toward the lid 19 beyond the bottom surface 17a of the recess portion 17. Therefore, the protruding portion 10c can be strongly held by the lid 19 and the groove portion 18 of the receiving seat 16. Further, in the lid 19, the surface opposed to the bottom surface 17a of the recess portion 17 and the surface opposed to the lower surface 10e of the protruding portion 10c are continuously formed on the same plane. Therefore, as compared to the case of using a lid having a convex upper surface, the generation of local stress at the lid 19 can be suppressed. Further, since the lid 19 is only required to be fitted in the recess portion 17, the requirement of the positional accuracy can be relaxed, and the machining and production of the lid 19 can be easily performed. The internal screw holes 20 for fastening the bolts are formed on the bottom surface 17a of the recess portion 17. Therefore, the lid 19 does not have to significantly protrude from the receiving seat 16, and compact appearance can be realized as compared to a case where the internal screw holes 20 are formed on the lower end surface 16a of the receiving seat 16.

[0026] The present invention is not limited to the above-described embodiment. Modifications, additions, and eliminations may be made with respect to the configuration of the present invention. For example, the portion 10f connecting the upper surface 10d and the lower surface 10e in the outer peripheral surface of the protruding portion 10c of the core rod 10 may be a surface which is not inclined relative to the direction of the fastening of the bolt B and is parallel to the direction of the fastening of the bolt B. The groove portion 18 does not have to include the tapered surfaces 18b and may include only the circular-arc surface 18a. The tubular portion 9 may have a two-piece structure including front and rear pieces, a two-piece structure including upper and lower pieces, or an integrated structure.

[0027] The direction in which the bolt B is fastened is not limited to the vertical direction and may be a direction inclined with respect to the vertical direction. The side sills may be omitted from the bogie frame, and the receiving seats 16 may be provided at the cross beam of the bogie frame. In this case, a plate spring extending in the car longitudinal direction may be used as the axle spring instead of the coil spring, a middle portion of the plate spring may support the cross beam, and both longitudinal direction end portions of the plate spring may be supported by the axle boxes. The core rod 10 is fitted into the groove portion 18 from below. However, the positions of the groove portion 18 and the lid 19 may be vertically reversed, and the core rod 10 may be fitted into the groove portion 18 from above. The axle box suspension is an axle beam type as one example in the present embodiment, but the present embodiment is not limited to this, and various types may be used.

Reference Signs List

[0028]	1	axle box suspension
	4	axle box
	5	bogie frame
	8	axle beam
	9	tubular portion
	10	core rod
	10c	protruding portion
	10d	upper surface (circular-arc surface)
	11	elastic bushing
	16	receiving seat
	17	recess portion
	17a	bottom surface
	17b	side surface

- 18 groove portion
- 18a circular-arc surface
- 19 lid
- 20 internal screw hole
- B bolt (fastener)

CLAIMS

1. An axle box suspension of a railcar, the axle box suspension coupling an axle box to a bogie frame,
the axle box suspension comprising:
a coupler extending from the axle box in a car longitudinal direction and including a tubular portion at a tip end portion of the coupler, the tubular portion being open toward both sides in a car width direction, the coupler coupling the axle box and the bogie frame;
a core rod inserted into an internal space of the tubular portion, a pair of protruding portions being provided at both respective sides of the core rod in the car width direction;
an elastic bushing interposed between the tubular portion and the core rod;
a pair of receiving seats provided at the bogie frame and including a pair of recess portions and a pair of groove portions formed by depressing parts of bottom surfaces of the pair of recess portions;
a pair of lids supporting the pair of protruding portions fitted into the pair of groove portions, the pair of lids being fitted into the pair of recess portions; and
fasteners fixing the lids to the receiving seats.
2. The axle box suspension according to claim 1, wherein a surface of the lid which surface is opposed to the bottom surface of the recess portion and a surface of the lid which surface is opposed to a lower surface of the protruding portion are continuously formed on the same plane.
3. The axle box suspension according to claim 1 or 2, wherein:
each of a contact surface of the protruding portion and a contact surface of the groove portion which surfaces contact each other has a circular-arc surface; and
each of a pair of car longitudinal direction side surfaces of the recess portion includes a flat surface parallel to a direction in which the fasteners are fastened.
4. The axle box suspension according to any one of claims 1 to 3, wherein with the protruding portion fitted into the groove portion, the protruding portion projects toward the lid beyond the bottom surface of the recess portion.
5. The axle box suspension according to any one of claims 1 to 4, wherein:
internal screw holes are formed on the bottom surface of the recess portion so as to be located at both respective sides of the groove portion;
the fasteners are fastened to the internal screw holes through the lid.
6. The axle box suspension according to any one of claims 1 to 5, wherein each of the lids has a rectangular solid shape.

7. The axle box suspension according to any one of claims 1 to 6, wherein the coupler is an axle beam.