

DESCRIPTION

Title: ELASTIC BUSHING DEVICE OF TRACTION DEVICE AND RAILCAR BOGIE

Technical Field

[0001] The present disclosure relates to an elastic bushing device for use in a traction device connecting a center pin and a bogie in a railcar, and a railcar bogie.

Background Art

[0002] A railcar is provided with a traction device configured to transmit force, such as driving force, acting in a front-rear direction between a car body and a bogie (see PTL 1, for example). In the traction device, a center pin provided under a floor of the car body is fitted into a rubber bushing device internally fitted to a tubular center pin receiver of a bogie frame. Thus, the car body and the bogie are coupled to each other.

Citation List

Patent Literature

[0003] PTL 1: Japanese Patent No. 5945137

Summary

Technical Problem

[0004] In the rubber bushing device, a multi-layer rubber body is interposed between an inner tube and an outer tube. According to the rubber bushing device configured as above, it is desirable that when the center pin moves toward one side in a horizontal direction relative to the center pin receiver, and therefore, the multi-layer rubber body is compressed at this side, the multi-layer rubber body is still being compressed at the other side. To be specific, it is desirable that the multi-layer rubber body is accommodated between the inner tube and the outer tube in a precompressed state. However, device cost of the rubber bushing device in which the multi-layer rubber body is accommodated between the inner tube and the outer tube in a precompressed state tends to become high due to reasons in manufacture.

[0005] An object of the present disclosure is to reduce cost of an elastic bushing device of a traction device of a railcar.

Solution to Problem

[0006] An elastic bushing device of a traction device according to one aspect of the present disclosure is an elastic bushing device for use in a traction device connecting a center pin and a

bogie in a railcar. The elastic bushing device includes: an outer tube supported by the bogie; an inner tube into which the center pin is fitted, the inner tube being arranged at a radially inner side of the outer tube so as to be spaced apart from the outer tube and also arranged so as to be located higher in position than the outer tube; and an elastic body sandwiched between the inner tube and the outer tube. An outer peripheral surface, opposed to the elastic body, of the inner tube is inclined downward. An inner peripheral surface, opposed to the elastic body, of the outer tube is inclined upward. The elastic body has such a shape that a surface thereof located close to the inner tube is located higher in position than a surface thereof located close to the outer tube.

[0007] According to the above configuration, when railcar assembly work of fitting the center pin into the inner tube of the elastic bushing from above is performed, the inner tube moves downward as the center pin moves downward. As the inner tube moves so as to become the same in height as the outer tube, the elastic body is compressed between the outer peripheral surface of the inner tube and the inner peripheral surface of the outer tube. To be specific, the elastic body of the elastic bushing can be precompressed only by performing the assembly work. Therefore, it is unnecessary to use an expensive elastic bushing which has already been precompressed before the railcar is assembled, and thus, the cost can be reduced.

Advantageous Effects

[0008] According to the present disclosure, the cost of the elastic bushing device of the traction device of the railcar can be reduced.

Brief Description of Drawings

[0009] FIG. 1 is a side view of a railcar bogie according to an embodiment when viewed from a car width direction.

FIG. 2 is a plan view of the bogie of FIG. 1 when viewed from above.

FIG. 3 is a perspective view of a center pin of FIG. 1.

FIG. 4 is a perspective view of an elastic bushing device of FIG. 2.

FIG. 5 is a plan view of the elastic bushing device of FIG. 4.

FIG. 6 is a sectional view showing the elastic bushing device and its vicinity before a railcar is assembled.

FIG. 7 is a sectional view showing the elastic bushing device and its vicinity after the railcar is assembled.

Description of Embodiments

[0010] Hereinafter, an embodiment will be described with reference to the drawings. In the following description, a direction in which a railcar travels and a car body extends is defined as a car longitudinal direction, and a lateral direction perpendicular to the car longitudinal direction is defined as a car width direction. The car longitudinal direction is also referred to as a front-rear direction, and the car width direction is also referred to as a left-right direction.

[0011] FIG. 1 is a side view of a bogie 1 of the railcar according to the embodiment when viewed from the car width direction. FIG. 2 is a plan view of the bogie 1 of FIG. 1 when viewed from above. As shown in FIG. 1, the bogie 1 supports a car body 2 of the railcar from below. The bogie 1 includes a bogie frame 4 supporting the car body 2 through an air spring (not shown). As shown in FIG. 2, the bogie frame 4 includes a cross beam 4a and a pair of side sills 4b. The cross beam 4a extends in the car width direction, and the pair of side sills 4b are connected to both car width direction end portions of the cross beam 4a and extend in the car longitudinal direction. A pair of wheelsets 5 are arranged at both car longitudinal direction sides of the bogie frame 4 so as to be located away from each other in the car longitudinal direction. Each of the wheelsets 5 includes an axle 5a and a pair of wheels 5b. The axle 5a extends in the car width direction, and the pair of wheels 5b are provided at the axle 5a.

[0012] As shown in FIG. 1, a bearing 6 rotatably supporting the axle 5a is accommodated in an axle box 7. A spring 8 (coil spring, for example) serving as a primary suspension is interposed between the axle box 7 and a side sill 4b. The axle box 7 is elastically coupled to the bogie frame 4 through a coupling mechanism 9. The coupling mechanism 9 includes an axle beam 10, a receiving seat 11, an elastic tube 12, a core rod 13, and a lid 14. The coupling mechanism 9 constitutes a so-called axle beam type axle box suspension. The axle beam 10 is formed integrally with the axle box 7 and projects from the axle box 7 toward a bogie middle side in the car longitudinal direction.

[0013] The receiving seat 11 is provided at the bogie frame 4 so as to project toward the axle beam 10. The elastic tube 12 is accommodated in a tubular portion (not shown) which is a tip end portion of the axle beam 10 and is open toward both sides in the car width direction. The elastic tube 12 is cylindrical and is arranged such that an axis thereof extends in the car width direction. The core rod 13 is accommodated in a radially inner side of the elastic tube 12. The core rod 13 projects toward both sides in the car width direction beyond the elastic tube 12. Both end portions of the core rod 13 are fitted in groove portions 11a of the receiving seat 11 and are supported by the lid 14 which is fastened to the receiving seat 11 so as to close the groove portions 11a.

[0014] As shown in FIG. 2, a traction motor 15 is attached to the cross beam 4a. A reduction gear 16 is connected to the axle 5a. Rotational power of the traction motor 15 is transmitted to the axle 5a through the reduction gear 16, and this drives, i.e., rotates the wheels 5b. A center pin receiver 17 including a cylindrical inner peripheral surface is provided at a middle of the cross beam 4a. A substantially cylindrical elastic bushing device 18 is inserted into the center pin receiver 17. A center pin 19 is inserted into the elastic bushing device 18. The center pin 19 is fixed to an underframe of the car body 2 and projects downward from an underfloor. To be specific, the center pin receiver 17, the elastic bushing device 18, and the center pin 19 serve as a traction device 20 configured to transmit tractive effort of the bogie 1 to the car body 2.

[0015] FIG. 3 is a perspective view of the center pin 19 of FIG. 1. As shown in FIG. 3, the center pin 19 includes a shaft portion 21 and a flange portion 22 projecting from an upper end of the shaft portion 21 in directions perpendicular to an axis of the shaft portion 21. Bolt holes 21a are formed on a lower end surface of the shaft portion 21. A key extending in a direction along the axis of the shaft portion 21 as an engaged portion 21b projects from an outer peripheral surface of the shaft portion 21. Bolt holes 22a are formed on the flange portion 22 and are used to fix the center pin 19 to the underframe of the car body 2. For example, the shaft portion 21 may be formed by a pipe material, and the flange portion 22 may be formed by bending a steel plate or may be a cast product or a forged product. The center pin 19 is formed by: separately manufacturing the shaft portion 21 and the flange portion 22; and then welding the shaft portion 21 and the flange portion 22 to each other. Therefore, the shaft portions 21 having different lengths are only required to be prepared depending on the types of the railcars. On this account, the flange portion 22 can be used among different types of the railcars, and the number of parts can be reduced.

[0016] FIG. 4 is a perspective view of the elastic bushing device 18 of FIG. 2. FIG. 5 is a plan view of the elastic bushing device 18 of FIG. 4. As shown in FIGS. 4 and 5, the elastic bushing device 18 includes an outer tube 31, an inner tube 32, and an elastic body 33. The outer tube 31 is supported by the center pin receiver 17 (see FIG. 2) of the bogie 1. The inner tube 32 is arranged at a radially inner side of the outer tube 31 so as to be spaced apart from the outer tube 31, and the center pin 19 (see FIG. 3) is fitted into the inner tube 32. The elastic body 33 is sandwiched between the outer tube 31 and the inner tube 32. The inner tube 32 is arranged so as to be located higher in position than the outer tube 31 (see FIG. 6). The elastic body 33 has such a shape that a surface thereof located close to the inner tube 32 is located higher in position than a surface thereof located close to the outer tube 31. The elastic body 33

has such a shape as to extend upward as it approaches from the outer tube 31 toward the inner tube 32.

[0017] Specifically, the elastic body 33 includes a pair of multi-layer rubber bodies 40. It should be noted that materials other than rubber may be used as an elastic material. Each of the multi-layer rubber bodies 40 includes: three circular-arc rubber layers 41 to 43 laminated concentrically; and two circular-arc plates 44 and 45 interposed between the circular-arc rubber layers 41 to 43. It should be noted that the number of circular-arc rubber layers and the number of circular-arc plates are not limited to these and may be changed in accordance with a space. The three circular-arc rubber layers 41 to 43 are arranged like stairs so as to become higher in position in a direction from the outer tube 31 toward the inner tube 32. In a no-load state in which the outer tube 31 and the inner tube 32 are concentrically arranged, the circular-arc rubber layers 41 to 43 are not being precompressed.

[0018] The pair of multi-layer rubber bodies 40 are arranged at both sides of the inner tube 32 in the car longitudinal direction. In an area between the outer tube 31 and the inner tube 32, spaces S are formed at both sides of the inner tube 32 in the car width direction. With this, the elastic bushing device 18 has a high elastic coefficient in the car longitudinal direction and a low elastic coefficient in the car width direction. When displacement in the car width direction increases, a space surrounded by the circular-arc plates 44 and 45 and the inner and outer tubes 32 and 31 narrows, and the circular-arc rubber layers 41 to 43 are compressed. Thus, the elastic coefficient in the car width direction becomes high. When the displacement in the car longitudinal direction further increases, the inner tube 32 and the outer tube 31 contact each other to serve as a stopper. As above, the elastic bushing device 18 can transmit not only the force acting in the car longitudinal direction but also the force acting in the car width direction, and therefore, can also serve as a lateral displacement stopper of a conventional bogie. The arrangement configuration of the multi-layer rubber bodies 40 is not limited to this and may be other configurations (for example, a configuration in which cylindrical rubber includes lightened parts) as long as arrangement density of rubber at both sides of the inner tube 32 in the car width direction is lower than arrangement density of rubber at both sides of the inner tube 32 in the car longitudinal direction.

[0019] The inner tube 32 includes an engaging portion 32a which engages with the center pin 19 such that the inner tube 32 is unrotatable relative to the center pin 19. Specifically, a keyway extending in the upper-lower direction is formed on an inner peripheral surface of the inner tube 32 as the engaging portion 32a. The key that is the engaged portion 21b of the shaft portion 21 of the center pin 19 is engaged with the engaging portion 32a. Since the center pin

19 does not rotate relative to the inner tube 32 as above, there is no slide portion, and the ease of maintenance is excellent. In the present embodiment, one keyway is provided. However, a plurality of keyways may be provided. Moreover, the present embodiment is not limited to the keyway, and a mechanism, such as a spline, configured to prevent relative rotation may be used.

[0020] FIG. 6 is a sectional view showing the elastic bushing device 18 and its vicinity before the railcar is assembled. As shown in FIG. 6, the center pin receiver 17 includes a projecting portion 17a projecting from an inner peripheral surface of the center pin receiver 17 toward a center of the center pin receiver 17. The projecting portion 17a is formed continuously with the inner peripheral surface of the center pin receiver 17 by subjecting the inner peripheral surface of the center pin receiver 17 to machine work. The elastic bushing device 18 is fitted into the center pin receiver 17 from above. A support peripheral surface 17b which is part of the inner peripheral surface of the center pin receiver 17 and located above the projecting portion 17a supports an outer peripheral surface of the outer tube 31 in a horizontal direction.

[0021] A support bottom surface 17c that is an upper surface of the projecting portion 17a of the center pin receiver 17 supports a lower end of the outer tube 31 from below. The outer tube 31 of the elastic bushing device 18 is directly fitted into the center pin receiver 17 and contacts the inner peripheral surface of the center pin receiver 17. As above, since the outer tube 31 of the elastic bushing device 18 is directly fitted into the center pin receiver 17, it is unnecessary to provide a structure in which a support sleeve supporting the outer tube 31 is welded and fixed to the inner peripheral surface of the center pin receiver 17. Therefore, manufacturing steps of the bogie can be reduced.

[0022] An inner peripheral surface 31a, opposed to the multi-layer rubber body 40, of the outer tube 31 is inclined upward. An outer peripheral surface 32a, opposed to the multi-layer rubber body 40, of the inner tube 32 is inclined downward. To be specific, the inner peripheral surface 31a and the outer peripheral surface 32a which are opposed to each other are formed in a conical shape which increases in diameter toward an upper side. The inner peripheral surface 31a and the outer peripheral surface 32a are substantially parallel to each other in a vertical sectional view. The circular-arc rubber layers 41 to 43 arranged like stairs are sandwiched between the inclined inner peripheral surface 31a and the inclined outer peripheral surface 32a in a direction that is oblique relative to the horizontal direction.

[0023] FIG. 7 is a sectional view showing the elastic bushing device 18 and its vicinity after the railcar is assembled. As shown in FIG. 7, when assembling the railcar, the shaft portion 21 of the center pin 19 is fitted into an inner space of the inner tube 32 of the elastic bushing device

18 from above. Then, an upper end surface of the inner tube 32 of the elastic bushing device 18 is pushed downward by the center pin 19 to move downward. With this, the circular-arc rubber layers 41 to 43 are compressed by the inner peripheral surface 31a of the outer tube 31 and the outer peripheral surface 32a of the inner tube 32, and the inner tube 32 becomes substantially the same in height as the outer tube 31. After the railcar is assembled, the circular-arc rubber layers 41 to 43 are being precompressed between the outer tube 31 and the inner tube 32.

[0024] Finally, a height stopper plate 46 is fixed by bolts B to the lower end surface of the shaft portion 21 of the center pin 19 which projects downward beyond the center pin receiver 17. A diameter of the height stopper plate 46 is larger than a minimum inner diameter (inner diameter of the projecting portion 17a) of the center pin receiver 17. In the present embodiment, the height stopper plate 46 has a circular shape. However, the shape of the height stopper plate 46 is not limited to this. The height stopper plate 45 may have a different shape, such as a rectangular shape, as long as the height stopper plate 45 projects in a radial direction at somewhere on a circumference of a hole of the center pin receiver 17.

[0025] According to the above-described configuration, when railcar assembly work of fitting the center pin 19 into the inner tube 32 of the elastic bushing device 18 from above is performed, the inner tube 32 moves downward as the center pin 19 moves downward. As the inner tube 32 moves so as to become the same in height as the outer tube 31, the elastic body 33 is compressed between the outer peripheral surface 32a of the inner tube 32 and the inner peripheral surface 31a of the outer tube 31. To be specific, the elastic body 33 of the elastic bushing device 18 can be precompressed only by performing the assembly work. Therefore, it is unnecessary to use an expensive elastic bushing which has already been precompressed before the railcar is assembled, and thus, the cost can be reduced. Moreover, since the elastic bushing device 18 can transmit the force in the car longitudinal direction and the force in the car width direction and serves as a traction link and lateral displacement stopper of a conventional bogie, these members of the conventional bogie can be omitted, and thus, the cost can be reduced.

[0026] Moreover, the inner tube 32 of the elastic bushing device 18 engages with the center pin 19 so as to be unrotatable relative to the center pin 19. Therefore, when, for example, the railcar turns, the center pin 19 rotates integrally with the inner tube 32, and relative rotation between the inner tube 32 and the outer tube 31 is absorbed by elasticity of the elastic body 33 in a shearing direction. On this account, it is unnecessary to interpose, for example, a sliding part between the center pin 19 and the inner tube 32. Thus, the configuration of the traction device 20 can be simplified, and the cost can be reduced.

[0027] The above embodiment has described a bolsterless bogie. However, the traction

device 20 may be applied to a bolster-equipped bogie instead of the bolsterless bogie. In this case, the center pin may project downward from the bolster.

Reference Signs List

[0028]	1	bogie
	4	bogie frame
	17	center pin receiver
	17b	support peripheral surface
	17c	support bottom surface
	18	elastic bushing device
	19	center pin
	20	traction device
	31	outer tube
	31a	inner peripheral surface
	32	inner tube
	32a	outer peripheral surface
	33	elastic body

CLAIMS

1. An elastic bushing device for use in a traction device connecting a center pin and a bogie in a railcar,
the elastic bushing device comprising:
an outer tube supported by the bogie;
an inner tube into which the center pin is fitted, the inner tube being arranged at a radially inner side of the outer tube so as to be spaced apart from the outer tube and also arranged so as to be located higher in position than the outer tube; and
an elastic body sandwiched between the inner tube and the outer tube, wherein:
an outer peripheral surface, opposed to the elastic body, of the inner tube is inclined downward;
an inner peripheral surface, opposed to the elastic body, of the outer tube is inclined upward; and
the elastic body has such a shape that a surface thereof located close to the inner tube is located higher in position than a surface thereof located close to the outer tube.
2. The elastic bushing device according to claim 1, wherein the inner tube includes an engaging portion which engages with the center pin such that the inner tube is unrotatable relative to the center pin.
3. A railcar bogie comprising:
the elastic bushing device according to claim 1 or 2; and
a bogie frame including a center pin receiver, the center pin receiver including an inner peripheral surface supporting the elastic bushing device, wherein:
the outer tube of the elastic bushing device is directly fitted into the center pin receiver;
a projecting portion projecting from the inner peripheral surface of the center pin receiver toward a center of the center pin receiver is formed continuously with the inner peripheral surface of the center pin receiver;
a support peripheral surface which is a part of the inner peripheral surface of the center pin receiver and located above the projecting portion supports an outer peripheral surface of the outer tube in a horizontal direction; and
a support bottom surface which is an upper surface of the projecting portion supports a lower end of the outer tube from below.