



Description

LOW FLOOR VEHICLE

Technical Field

[0001]

The present invention relates to a low floor vehicle that travels on a track.

Background Art

[0002]

In recent years, streetcars and the like have adopted low floor vehicle designs in which a floor surface in the vehicle is set close to a road surface to reduce the difference in level for stepping up and down for passengers so as to make the vehicles barrier-free. In such a streetcar, because of limitations such as road traffic conditions, a large number of curved tracks curving with a curvature radius equal to or less than 20 m are provided. A low floor vehicle having a low center of gravity because of the structure thereof can travel relatively stably on such curved tracks. However, there is a problem in that, when the vehicle enters a curved track, an angle in a traveling direction of wheels with respect to a tangential direction of the curved track (hereinafter referred to as "attack angle") increases. When this attack angle is large, in wheels present on an outside rail during travel on the curved track, in some cases, flanges of the wheels come into contact with the track. At this point, pressure is applied from the wheel flanges to the vehicle, the lateral pressure of the vehicle increases, and vibration and creaking sounds occur in the vehicle. As a result, there is a problem in that riding comfort for passengers is degraded and the wheel flanges wear out.

[0003]



Taking such a problem into account, a low floor vehicle called an LRV (Light Rail Vehicle) as disclosed in Patent Document 1 has been developed. In Figure 7, an example of the configuration of this LRV is shown. A traveling direction of this LRV is indicated by an arrow A. In the explanation, it is assumed that the traveling direction is to the vehicle front. Referring to Figure 7, the LRV includes two front vehicles 102 and one intermediate vehicle 103 traveling on a track 101. As a vehicle composition, the one intermediate vehicle 103 is arranged between the two front vehicles 102.

[0004]

Pin connectors 105 are arranged along an axis extending in a vehicle vertical direction in connecting sections 104 between the front vehicles 102 and the intermediate vehicle 103. The front vehicles 102 are coupled to the intermediate vehicle 103 to be capable of turning around the pin connectors 105. Therefore, the front vehicles 102 and the intermediate vehicle 103 can curve around the pin connectors 105 to correspond to a curvature radius R of the curved track 101. Furthermore, in the connecting sections 104, dampers, springs, or the like (not shown) are provided to suppress the turning of the front vehicles 102 and secure safety during high-speed travel of the vehicle.

[0005]

Bogies 107 are arranged under vehicle bodies 106 of the front vehicles 102. As shown in Figures 8 to 10, a pair of wheels 108 is provided at each of a vehicle front direction and a vehicle rear direction of the bogie 107. The pair of wheels 108 are configured to be pivotable independently of each other around the same axis 108a extending in a vehicle lateral direction and coupled by a journal member 109. The journal member 109 is arranged at each of a vehicle front direction and a vehicle rear

direction of each of bogie frames 110 formed as frame members of the bogie 107. Conical rubber 111 is provided as a shaft spring for the wheel 108 between the journal member 109 and the bogie frame 110. Vibration transmitted from the wheel 108 to the bogie frame 110 is suppressed by this conical rubber 111. Furthermore, the journal member 109 extends at a position close to the road surface between the pair of wheels 108. A floor surface (not shown) in the vehicle is arranged at the journal member 109. Therefore, the floor surface in the vehicle is configured to be close to the road surface.

[0006]

Referring to Figure 7 again, when the vehicle traveling in the traveling direction enters the curved track 101, force directed in a straight forward direction by inertia acts on the vehicle bodies 106. Force directed in a curving direction along the curved track 101 acts on the bogies 107. Therefore, force acting on the entire front vehicles 102 is unbalanced. At this point, the straight forward force by inertia also affects the bogies 107. The bogies 107 are less easily curved along the curved track 101. As a result, an attack angle α , which is an angle in the traveling direction (indicated by an arrow C) of the wheel 108 with respect to the tangential direction (indicated by an arrow B) of the curved track, increases. It is likely that wheel flanges 108b (shown in Figures 8 to 10) of the wheels 108 on an outside rail side come into contact with the track. At the time of this contact, pressure is applied from the wheel flanges 108b to the vehicle, lateral pressure of the vehicle increases, and vibration and creaking sounds occur in the vehicle. As a result, there is a problem in that riding comfort of passengers is degraded and the wheel flanges 108b wear out.

[0007]

To absorb such unbalance of force, the bogies 107 are configured to be movable in the vehicle lateral direction with respect to the vehicle bodies 106. Specifically, as shown in Figures 8 to 10, traction rods 112 that transmit traction force of the bogie 107 to the vehicle body 106 are arranged along a vehicle longitudinal direction. Ends 112a on the vehicle rear direction of the traction rods 112 are attached to the bogie 107 side via a spherical bush or a rubber vibration insulator (not shown). Ends 112b on the vehicle front direction of the traction rods 112 are attached to the vehicle body 106 side via a spherical bush or a rubber vibration insulator (not shown).

Citation List

Patent Literature

[0008]

Patent Literature 1: Japanese Patent Laid-Open No. 2008-132828

Summary of Invention

Technical Problem

[0009]

However, in the vehicle of Patent Document 1, as shown in Figure 7, the front vehicles 102 and the intermediate vehicle 103 are about to curve around the pin connectors 105 to correspond to the curvature radius R of the curved track 101 during the traveling of the vehicle on the curved track. However, in some cases, the front vehicles 102 do not sufficiently curve with respect to the intermediate vehicle 103 because of the influence of the dampers of the connecting sections 104. In some cases, the wheels 108 do not curve along the curved track while being affected by cant, slack, or the like of the curved track. In this case, it is likely that the traveling direction (indicated by the arrow B) of the wheels 108 does not face the

tangential direction (indicated by the arrow C) of the curved track 101 and the attack angle α increases. Therefore, the pressure still applies from the wheel flanges 108b to the vehicle, the lateral pressure of the vehicle increases, and vibration and creaking sounds occur in the vehicle. As a result, there is a problem in that riding comfort of passengers is degraded and the wheel flanges 108b wear out.

[0010]

Another problem is that since a difference between forces acting on the vehicle bodies 106 and the bogies 107 is absorbed when the vehicle enters the curved track, it is likely that, even if the bogies 107 move in the vehicle lateral direction with respect to the vehicle bodies 106, the straight forward force by inertia is large and imbalance of the force cannot be completely absorbed. In this case, the bogies 107 are still affected by the straight forward force by inertia. In some cases, the attack angle α increases. Therefore, the pressure is still applied from the wheel flanges 108b to the vehicle, the lateral pressure of the vehicle increases, and vibration and creaking sounds occur in the vehicle. As a result, there is a problem in that riding comfort of passengers is degraded and the wheel flanges 108b wear out.

[0011]

The present invention has been devised in view of such circumstances, and it is an object of the present invention to provide a low floor vehicle that can reduce, when the vehicle enters a curved track, the lateral pressure of the vehicle, prevent occurrence of vibration and creaking sounds of the vehicle, improve riding comfort of passengers, and reduce wear of wheel flanges.

Solution to Problem

[0012]

In order to solve the problems, a low floor vehicle of the present invention is a low floor vehicle including: a bogie provided under a vehicle body; a bogie frame configured as a frame member of the bogie; a pair of bogie frame cross beams arranged along a vehicle lateral direction in the middle of a vehicle longitudinal direction of the bogie frame and arranged spaced apart from each other in the vehicle longitudinal direction; and a pair of wheels provided in each of a vehicle front direction and a vehicle rear direction by the pair of bogie frame cross beams of the bogie frame and configured to travel on a track, wherein a pair of flexible traction rods arranged along the vehicle longitudinal direction and configured to be capable of extending and retracting in the vehicle longitudinal direction are provided in the bogie, the pair of flexible traction rods are arranged spaced apart from each other in a vehicle lateral direction, ends of the flexible traction rods are attached to the bogie frame cross beams, and the other ends of the flexible traction rods are attached to a receiving section provided in the vehicle body, and the bogie is configured to be capable of turning with respect to the vehicle body.

[0013]

Furthermore, in order to solve the problems, a low floor vehicle of the present invention is a low floor vehicle including: a bogie provided under a vehicle body; a bogie frame configured as a frame member of the bogie; a pair of bogie frame cross beams arranged along a vehicle lateral direction in the middle of a vehicle longitudinal direction of the bogie frame and arranged spaced apart from each other in the vehicle longitudinal direction; and a pair of wheels provided in each of a vehicle front direction and a vehicle rear direction with respect to the pair of bogie frame cross beams of the bogie frame and configured to travel on a track, wherein one traction rod arranged along the vehicle longitudinal direction in the center in a

vehicle lateral direction is provided in the bogie, one end of the traction rod is attached to the bogie frame cross beam, and the other end of the traction rod is attached to a receiving section provided in the vehicle body, a restoring rod arranged along the vehicle longitudinal direction and configured to be capable of extending and retracting in the vehicle longitudinal direction is provided at least one of left and right outer sides in the vehicle lateral direction of the traction rod, one end of the restoring rod is attached to the bogie frame cross beam, and the other end of the restoring rod is attached to the receiving section provided in the vehicle body, and the bogie is configured to be capable of turning with respect to the vehicle body.

[0014]

In the low floor vehicle of the present invention, a turn suppression damper arranged along the vehicle lateral direction and configured to be capable of attenuating force in the vehicle lateral direction is provided in each of a front direction section of the bogie frame cross beam on the vehicle front direction and a rear direction section of the bogie frame cross beam on the vehicle rear direction, one end of the turn suppression damper is attached to the bogie frame cross beam, the other end of the turn suppression damper is attached to the receiving section provided in the vehicle body, and a stopper provided in the vehicle body and a stopper member provided in the bogie are arranged to be capable of coming into contact with each other to regulate a turn of the vehicle body.

Advantageous Effects of Invention

[0015]

According to the present invention, effects explained below can be obtained. A low floor vehicle of the present invention is a low floor vehicle including: a bogie provided under a vehicle body; a bogie frame configured as a frame member of the

bogie; a pair of bogie frame cross beams arranged along a vehicle lateral direction in the middle of a vehicle longitudinal direction of the bogie frame and arranged spaced apart from each other in the vehicle longitudinal direction; and a pair of wheels provided in each of a vehicle front direction and a vehicle rear direction with respect to the pair of bogie frame cross beams of the bogie frame and configured to travel on a track, wherein a pair of flexible traction rods arranged along the vehicle longitudinal direction and configured to be capable of extending and retracting in the vehicle longitudinal direction are provided in the bogie, the pair of flexible traction rods are arranged spaced apart from each other in a vehicle lateral direction, ends of the flexible traction rods are attached to the bogie frame cross beams, the other ends of the flexible traction rods are attached to a receiving section provided in the vehicle body, and the bogie is configured to be capable of turning with respect to the vehicle body.

Therefore, when the vehicle enters a curved track, if a wheel on an outside rail side of the pair of wheels comes into contact with the track and force directed to the inner side in the vehicle lateral direction is applied to the wheel on the outside rail side, force for turning with respect to the vehicle body acts on the bogie. At this point, one of the pair of flexible traction rods extends and the other of the pair of flexible traction rods retracts, whereby the bogie can turn with respect to the vehicle body. Force directed in a straight forward direction by the inertia of the vehicle body is absorbed by such a turn of the bogie and less easily affects the bogie. The bogie easily curves along the curved track. As a result, the wheel changes to a state more closely along the curved track and the vehicle can enter the curved track at a small attack angle. Therefore, when the vehicle enters the curved track, contact pressure between the wheel on the outside rail side and the track is relaxed, lateral

pressure applied to the vehicle is reduced, and occurrence of vibration and creaking sound of the vehicle is prevented. Therefore, riding comfort of passengers is improved and wear of a wheel flange is reduced. In other words, the vehicle can smoothly pass the curved track.

[0016]

A low floor vehicle of the present invention is a low floor vehicle including: a bogie provided under a vehicle body; a bogie frame configured as a frame member of the bogie; a pair of bogie frame cross beams arranged along a vehicle lateral direction in the middle of a vehicle longitudinal direction of the bogie frame and arranged spaced apart from each other in the vehicle longitudinal direction; and a pair of wheels provided in each of a vehicle front direction and a vehicle rear direction with respect to the pair of bogie frame cross beams of the bogie frame and configured to travel on a track, wherein one traction rod arranged along the vehicle longitudinal direction in the center in a vehicle lateral direction is provided in the bogie, one end of the traction rod is attached to the bogie frame cross beam, the other end of the traction rod is attached to a receiving section provided in the vehicle body, a restoring rod arranged along the vehicle longitudinal direction and configured to be capable of extending and retracting in the vehicle longitudinal direction is provided at least one of left and right outer sides in the vehicle lateral direction of the traction rod, one end of the restoring rod is attached to the bogie frame cross beam, the other end of the restoring rod is attached to the receiving section provided in the vehicle body, and the bogie is configured to be capable of turning with respect to the vehicle body.

Therefore, when the vehicle enters a curved track, if a wheel on an outside rail side of the pair of wheels comes into contact with the track and force directed to the

inner side in the vehicle lateral direction is applied to the wheel on the outside rail side, force for turning with respect to the vehicle body acts on the bogie. At this point, one of the pair of restoring rods extends and the other of the pair of restoring rods retracts, whereby the bogie can turn around the traction rod with respect to the vehicle body. Force directed in a straight forward direction by the inertia of the vehicle body is absorbed by such a turn of the bogie and less easily affects the bogie. The bogie easily curves along the curved track. As a result, the wheel changes to a state further along the curved track and can enter the curved track at a small attack angle. Therefore, when the vehicle enters the curved track, contact pressure between the wheel on the outside rail side and the track is relaxed, lateral pressure applied to the vehicle is reduced, and occurrence of vibration and creaking sounds of the vehicle is prevented. Therefore, riding comfort of passengers is improved and wear of wheel flanges is reduced. In other words, the vehicle can smoothly pass the curved track.

[0017]

In the low floor vehicle of the present invention, a turn suppression damper arranged along the vehicle lateral direction and configured to be capable of attenuating force in the vehicle lateral direction is provided in each of a front direction section of the bogie frame cross beam on the vehicle front direction and a rear direction section of the bogie frame cross beam on the vehicle rear direction, one end of the turn suppression damper is attached to the bogie frame cross beam, the other end of the turn suppression damper is attached to the receiving section provided in the vehicle body, and a stopper provided in the vehicle body and a stopper member provided in the bogie are arranged to be capable of coming into contact with each other to regulate a turn of the vehicle body. When external force from the

vehicle lateral direction is applied to the vehicle other than the force acting on the bogie from the track when the vehicle enters the curved track as explained above, such external force is attenuated by the turn suppression damper provided on each of the vehicle front direction and the vehicle rear direction. It is possible to prevent the bogie from being turned with respect to the vehicle body by force other than the force acting on the bogie from the track. Therefore, during linear track traveling of the vehicle or the like, the bogie does not turn with respect to the vehicle body and traveling stability of the vehicle is secured. Since a movement amount in the vehicle lateral direction of the bogie is limited by the stopper member, a large turn of the bogie is prevented and traveling stability of the vehicle is further secured. Therefore, it is possible to more surely obtain the effects explained above while securing traveling stability of the vehicle.

Brief Description of Drawings

[0018]

[Figure 1] Figure 1 is an explanatory diagram showing a low floor vehicle during linear track traveling in a first embodiment of the present invention.

[Figure 2] Figure 2 is a plan view showing a bogie of the vehicle in the first embodiment of the present invention.

[Figure 3] Figure 3 is a front view showing the bogie of the vehicle in the first embodiment of the present invention.

[Figure 4] Figure 4(a) is a longitudinal sectional view showing a schematic structure of a spring-type flexible traction rod in the vehicle in the first embodiment of the present invention. Figure 4(b) is a longitudinal sectional view showing a schematic structure of a rubber-type flexible traction rod.

[Figure 5] Figure 5 is an explanatory diagram showing the low floor vehicle during curved track traveling in the first embodiment of the present invention.

[Figure 6] Figure 6 is a plan view showing a bogie of a vehicle in a second embodiment of the present invention.

[Figure 7] Figure 7 is an explanatory diagram showing a conventional low floor vehicle during curved track traveling.

[Figure 8] Figure 8 is a plan view showing a bogie of the conventional vehicle.

[Figure 9] Figure 9 is a side view showing the bogie of the conventional vehicle.

[Figure 10] Figure 10 is a front view showing the bogie of the conventional vehicle.

Description of Embodiments

[0019]

First Embodiment

A low floor vehicle (hereinafter referred to as "vehicle") in a first embodiment of the present invention is explained below. In the first embodiment, the vehicle is explained using an LRV as shown in Figure 1 as an example of the vehicle. In the explanation, it is assumed that a traveling direction of the vehicle is a vehicle front. Figure 1 is a diagram of the vehicle viewed from above. The traveling direction of the vehicle is indicated by the arrow A. The vehicle shown in Figure 1 includes two front vehicles 2 and one intermediate vehicle 3 traveling on a track 1. As a vehicle composition, the one intermediate vehicle 3 is arranged between the two front vehicles 2. Connecting sections 4 are provided between the front vehicles 2 and the intermediate vehicle 3. Pin connectors 5 are provided in the connecting sections 4 along an axis extending in a vehicle vertical direction. The front vehicles 2 are coupled to the intermediate vehicle 3 to be capable of turning around the pin

connectors 5. Bogies 7 are provided under vehicle bodies 6 of the front vehicles 2. Wheels 8 provided in the bogies 7 are configured to travel on the track 1.

[0020]

The structure of the bogie 7 is explained with reference to the bogie 7 in a state during linear traveling shown in Figures 2 and 3. A traveling direction of the vehicle is indicated by the arrow A. In the bogie 7, a bogie frame 9 is provided as a frame member of the bogie 7. The vehicle body 6 (shown in Figure 1) is supported by this bogie frame 9. Two bogie frame cross beams 9a extending in a vehicle lateral direction are disposed in this bogie frame 9 spaced apart from each other in a vehicle longitudinal direction. Furthermore, in the bogie frame 9, two bogie frame side beams 9b extending in the vehicle longitudinal direction respectively cross the two bogie frame cross beams 9a and are disposed spaced apart from each other in the vehicle lateral direction.

[0021]

Journal members 10 respectively provided at the front end and the rear end of the bogie frame side beams 9b. Therefore, the bogie frame cross beams 9a are located closer to the center in the vehicle longitudinal direction than the journal members 10. A pair of wheels 8 are attached at both ends in the vehicle lateral direction of each of the journal members 10 to be pivotable independently from each other about the same axis 8a. Wheel flanges 8b are provided at edges on the inner side in the vehicle lateral direction of the wheels 8. The journal member 10 is configured to extend near the road surface between both ends to which the wheels 8 are attached. Conical rubbers 11 are disposed as shaft springs of the wheels 8 between the bogie frame side beams 9b and the ends of the journal member 10. The ends of the journal members 10 are attached to the bogie frame side beams 9b via the

conical rubbers 11. The conical rubbers 11 are configured to absorb vibrations from the wheels 8 in the vehicle vertical direction.

[0022]

Turn suppression dampers 12 are provided on the vehicle front direction and the vehicle rear direction of the bogie 7. The turn suppression dampers 12 are arranged along axes 12a extending in the vehicle lateral direction and tilt in the vehicle vertical direction. The turn suppression dampers 12 are configured to be capable of attenuating force applied from the vehicle lateral direction. The axes 12a of the turn suppression dampers 12 are apart from a middle point 13 of the bogie frame 9 in the vehicle longitudinal direction by a distance E. The middle point 13 of the bogie frame 9 is located at a crossing point of an axis 8c passing the center in the vehicle lateral direction of the pair of wheels 8 in a linear track traveling state and extending in the vehicle longitudinal direction and an axis 8d passing the center between the wheels 8 on the vehicle front direction and the vehicle rear direction in the linear track traveling state and extending along the vehicle lateral direction.

[0023]

One end of the turn suppression damper 12 on the vehicle front direction is attached to the front direction section of the bogie frame cross beam 9a on the vehicle front direction via a spherical flange. The other end of the turn suppression damper 12 on the vehicle front direction is attached to a receiving section 6a, which is provided in the vehicle body 6, via a spherical flange. One end of the turn suppression damper 12 on the vehicle rear direction is attached to the rear direction section of the bogie frame cross beam 9a on the vehicle rear direction via a spherical flange. The other end of the turn suppression damper 12 on the vehicle rear

direction is attached to the receiving section 6a, which is provided in the vehicle body 6, via a spherical flange.

[0024]

Stopper members 14 are provided on the vehicle front direction and the vehicle rear direction of the bogie 7. The stopper members 14 are arranged along the axes 12a of the turn suppression dampers 12 and attached to the bogie frame cross beams 9a. Stopper rubbers 14a are respectively provided in both directions sections of the stopper members 14 in the vehicle lateral direction. On the other hand, stopper receiving sections 6b are provided in the vehicle body 6 along the axes of the turn suppression dampers 12. The stopper members 14 are arranged between the receiving sections 6a and the stopper receiving sections 6b of the vehicle body 6. The stopper members 14 are arranged a distance F apart from the receiving sections 6a and the stopper receiving sections 6b of the vehicle body 6 in the vehicle lateral direction. Therefore, the turn of the vehicle body 6 is regulated by contact of the stopper members 14 on the bogie 7 side and the receiving sections 6a or the stopper receiving sections 6b on the vehicle body 6 side.

[0025]

A pair of flexible traction rods 15 are provided in the bogie 7. The flexible traction rods 15 are arranged along axes 15a extending in the vehicle longitudinal direction and configured to be capable of extending and retracting in the vehicle longitudinal direction. The axes 15a of the flexible traction rods 15 are a distance D apart from the middle point 13 of the bogie frame 9 in the vehicle lateral direction. Therefore, the pair of flexible traction rods 15 are arranged to be spaced apart from each other in the vehicle lateral direction to be symmetrical in the vehicle lateral direction. Ends 15b on the vehicle front direction of the flexible traction rods 15

are attached to receiving sections 6c, which are provided in the vehicle body 6 (shown in Figure 1), via spherical flanges. Ends 15c on the vehicle rear direction of the flexible traction rods 15 are attached to the bogie frame cross beam 9a on the vehicle rear direction via spherical flanges.

[0026]

With such a configuration, the bogie 7 is capable of turning $\theta = \tan^{-1}(F/E)$ at the maximum with respect to the vehicle body 6 about the middle point 13 of the bogie frame 9.

[0027]

An example of the structure of the flexible traction rod 15 is explaining with reference to Figure 4(a). In Figure 4(a), the flexible traction rod 15 is in a free supported state. The flexible traction rod 15 includes a piston rod 16 extending along a longitudinal direction of the flexible traction rod 15 and a cylindrical cylinder 17 extending along the longitudinal direction. A head section 16a is provided at the distal end of the piston rod 16. A cap section 16b is provided at the proximal end of the piston rod 16. A stopper section 16c is provided in the cap section 16b. A rod section 16d is provided between the head section 16a and the cap section 16b.

[0028]

Both ends 17a and 17b in a longitudinal direction of the cylinder 17 are formed to close. Through holes are bored at both ends to pierce the piston rod 16 through the cylinder 17 and make it possible to move the cap section 16b and the rod section 16d of the piston rod 16 in the longitudinal direction in the cylinder 17. The head section 16a of the piston rod 16 and the end 17a of the cylinder 17 located on the head section 16a direction are in contact with each other and regulate the piston rod 16 from moving in the longitudinal direction toward the cap section 16b direction.

On the other hand, the stopper section 16c of the piston rod 16 and the end 17b of the cylinder 17 located on the cap section 16b direction are arranged to be spaced a distance G apart from each other in the longitudinal direction. The piston rod 16 is movable by the distance G at the maximum in the longitudinal direction toward the head section 16a direction.

[0029]

Furthermore, a coil spring 18 is disposed in the cylinder 17 along the longitudinal direction. A guide washer 19 is disposed between this coil spring 18 and the end 17b of the cylinder 17 located on the cap 16b direction. This guide washer 19 is in contact with the cap section 16b of the piston rod 16. When the cap section 16b moves in the longitudinal direction toward the head section 16a direction, the guide washer 19 moves together with the cap section 16b and the coil spring 18 is compressed.

[0030]

Concerning the structure of the flexible traction rod 15, as another example, a rubber member 20 may be provided instead of the coil spring 18 as shown in Figure 4(b).

[0031]

Concerning the flexible traction rod 15 configured in this way, in Figure 2, the cap section 16b of the piston rod 16 is arranged in a state in which the cap section 16b moves to the head section 16a direction. Such a state is a neutral state of the flexible traction rod 15. Since the coil spring 18 is in the compressed state, a pre-load P is applied to the flexible traction rod 15. For example, this pre-load P may be a magnitude set from a load applied to the flexible traction rod 15 when maximum acceleration is applied to the vehicle when fully loaded and a margin of the load. It

is possible to prevent the bogie 7 from turning with respect to the vehicle body 6 because of the influence of vehicle weight or the like other than during curved track traveling. In other words, it is possible to secure traveling stability of the vehicle during linear track traveling. The structure of the flexible traction rod 15 shown in Figures 4(a) and 4(b) is only an example. The structure may be other structures as long as the flexible traction rod 15 is capable of extending and retracting.

[0032]

Concerning such a vehicle in the first embodiment, an operation in traveling a curved track is explained with reference to Figures 2, 3, and 5. Figure 5 is a diagram of the vehicle viewed from above. A traveling direction of the vehicle is indicated by the arrow A.

When the front vehicle 2 on the vehicle front direction enters the curved track, the wheel 8 on the outside rail side of the pair of wheels 8 comes into contact with the track 1 and force directed to the inner side in the vehicle lateral direction is applied to the wheel 8 on the outside rail side. Then, force for turning with respect to the vehicle body 6 acts on the bogie 7. At this point, one of the pair of flexible traction rods 15 extends and the other of the pair of flexible traction rods 15 retracts. Therefore, the bogie 7 turns by an angle θ at the maximum around the middle point 13 of the bogie frame 9 with respect to the vehicle body 6. Such an operation is also performed in the front vehicle 2 on the vehicle rear direction.

[0033]

As explained above, with the vehicle in the first embodiment of the present invention, force directed in the straight forward direction by the inertia of the vehicle body 6 is absorbed by the turn of the bogie 7 and less easily affects the bogie 7. The bogie 7 easily curves along the curved track. As a result, the wheel 8 changes

to a state more closely along the curved track and the vehicle can enter the curved track at a small attack angle. Therefore, when the vehicle enters the curved track, contact pressure between the wheel 8 on the outside rail side and the track 1 is relaxed, lateral pressure applied to the vehicle is reduced, and occurrence of vibration and creaking sounds of the vehicle are prevented. Therefore, riding comfort of passengers is improved and wear of the wheel flange 8b is reduced. In other words, the vehicle can smoothly pass the curved track.

[0034]

With the vehicle in the first embodiment of the present invention, when external force from the vehicle lateral direction is applied to the vehicle other than the force acting on the bogie 7 from the track 1 when the vehicle enters the curved track, such external force is attenuated by the turn suppression dampers 12 provided on the vehicle front direction and the vehicle rear direction. Therefore, it is possible to prevent the bogie 7 from being turned with respect to the vehicle body 6 by force other than the force acting on the bogie 7 from the track 1. Therefore, the bogie 7 turns with respect to the vehicle body 6 only when the vehicle enters the curved track. On the other hand, during linear track traveling of the vehicle or the like, the bogie 7 does not turn with respect to the vehicle body 6 and traveling stability of the vehicle is secured. Since a movement amount in the vehicle lateral direction of the bogie 7 is limited by the stopper members 14, a large turn of the bogie 7 is prevented and traveling stability of the vehicle is further secured.

[0035]

Second Embodiment

A vehicle in a second embodiment of the present invention is explained below. In the second embodiment, as in the first embodiment, the vehicle is explained using

an LRV as an example of the vehicle. A basic configuration of the vehicle in the second embodiment is the same as the configuration of the vehicle in the first embodiment. Components that are the same as those in the first embodiment are explained using the same reference numerals and signs and names as those in the first embodiment. Components different from those in the first embodiment are explained. In the explanation of the second embodiment, it is assumed that a traveling direction of the vehicle is to the vehicle front.

[0036]

The structure of the bogie 7 in the second embodiment is explained with reference to the bogie 7 in a linear traveling time state shown in Figure 6. One traction rod 21 is provided in the bogie 7. The traction rod 21 is arranged along the axis 8c passing the center between the wheels 8 on the vehicle front direction and the vehicle rear direction in a linear track traveling state and extending along the vehicle lateral direction. An end 21a on the vehicle rear direction of the traction rod 21 is attached to a receiving section 6d, which is provided in the vehicle body 6 (shown in Figure 1), via a spherical flange. An end 21b at the vehicle front direction of the traction rod 21 is attached to the bogie frame cross beams 9a on the vehicle rear direction via a spherical flange.

[0037]

A pair of restoring rods 22 configured the same as the flexible traction rods 15 in the first embodiment are provided in the bogie 7. As an example, the restoring rods 22 are respectively arranged on both left and right sides in the vehicle lateral direction of the traction rod 21. As another example, the restoring rod 22 may be provided only at one of the left and right sides in the vehicle lateral direction of the traction rod 21. An end 22a on the vehicle rear direction of the restoring rod 22 is

attached to a receiving section 6e, which is provided in the vehicle body 6 (shown in Figure 1), via a spherical flange. An end 22b on the vehicle front direction of the restoring rod 22 is attached to the bogie frame cross beam 9a on the vehicle rear direction via a spherical flange.

[0038]

Concerning such a vehicle in the second embodiment, an operation in traveling on a curved track is explained with reference to Figures 4 and 6.

When the front vehicle 2 on the vehicle front direction enters the curved track, the wheel 8 on the outside rail side of the pair of wheels 8 comes into contact with the track 1 and force directed to the inner side in the vehicle lateral direction is applied to the wheel 8 on the outside rail side. Then, force for turning with respect to the vehicle body 6 acts on the bogie 7. At this point, one of the pair of restoring rods 22 extends and the other of the pair of restoring rods 22 retracts while referring to the traction rod 21 as a support reference. Therefore, the bogie 7 turns by an angle θ at the maximum about the middle point 13 of the bogie frame 9 with respect to the vehicle body 6. Such an operation is also performed in the front vehicle 2 on the vehicle rear direction.

[0039]

As explained above, with the vehicle in the second embodiment of the present invention, force directed in the straight forward direction by the inertia of the vehicle body 6 is absorbed by the turn of the bogie 7 and less easily affects the bogie 7. The bogie easily curves along the curved track. As a result, the wheel 8 changes to a state more closely along the curved track and the vehicle can enter the curved track at a small attack angle. Therefore, when the vehicle enters the curved track, contact pressure between the wheel 8 on the outside rail side and the track 1 is relaxed,

lateral pressure applied to the vehicle is reduced, and occurrence of vibration and creaking sound of the vehicle is prevented. Therefore, riding comfort of passengers is improved and wear of the wheel flange 8b is reduced.

[0040]

With the vehicle in the second embodiment of the present invention, when external force from the vehicle lateral direction is applied to the vehicle other than the force acting on the bogie 7 from the track 1 when the vehicle enters the curved track, such external force is attenuated by the turn suppression dampers 12 provided on the vehicle front direction and the vehicle rear direction. Therefore, it is possible to prevent the bogie 7 from being turned with respect to the vehicle body 6 by force other than the force acting on the bogie 7 from the track 1. Therefore, the bogie 7 turns with respect to the vehicle body 6 only when the vehicle enters the curved track. On the other hand, during linear track traveling of the vehicle or the like, the bogie 7 does not turn with respect to the vehicle body 6 and traveling stability of the vehicle is secured. Since a movement amount in the vehicle lateral direction of the bogie 7 is limited by the stopper members 14, a large turn of the bogie 7 is prevented and traveling stability of the vehicle is further secured.

[0041]

The embodiments of the present invention have been explained. However, the present invention is not limited to the embodiments explained above. Various modifications and alterations are possible on the basis of the technical idea of the present invention.

[0042]

For example, as a first modification of the embodiments of the present invention, concerning composition of the vehicle, the number of front vehicles 2 and

the number of intermediate vehicles 3 may be different from those in the embodiments as long as the bogies 7 are provided in the front vehicles 2 and the one intermediate vehicle 3 is arranged between the two front vehicles 2. Effects that are the same as the effects explained in the embodiments can be obtained.

[0043]

As a second modification of the embodiments of the present invention, a rubber vibration insulator may be provided instead of the guide washer 19 of the flexible traction rods 15 or the restoring rods 22. Furthermore, it is possible to absorb a swing of the bogies 7 and effectively prevent occurrence of deflection of the journal members 10 and the wheels 8 involved in the swing.

Reference Sign List

[0044]

1	track
2	front vehicles
3	intermediate vehicle
4	connecting sections
5	pin connectors
6	vehicle bodies
6a, 6c, 6d, 6e	receiving sections
6b	stopper receiving sections
7	bogies
8	wheels
8a, 8c, 8d	axes
8b	wheel flanges
9	bogie frame

9a	bogie frame cross beams
9b	bogie frame side beams
10	journal members
11	conical rubbers
12	turn suppression dampers
12a	axes
12b, 12c	ends
13	middle point
14	stopper members
14a	stopper rubbers
15	flexible traction rods
15a	axes
15b, 15c	ends
16	piston rod
16a	head section
16b	cap section
16c	stopper section
16d	rod section
17	cylinder
17a, 17b	ends
18	coil spring
19	guide washer
20	rubber member
21	traction rod
21a, 21b	ends

22 restoring rods

22a, 22b ends

A, B, C arrows

D, E, F, G distances

O center

α , β , θ angles

Claims

[Claim 1]

A low floor vehicle comprising:

a bogie provided under a vehicle body;

a bogieframe configured as a frame member of the bogie;

a pair of bogie frame cross beams arranged along a vehicle lateral direction in a middle of a vehicle longitudinal direction of the bogie frame and arranged spaced apart from each other in the vehicle longitudinal direction; and

a pair of wheels provided in each of a vehicle front direction and a vehicle rear direction with respect to the pair of bogie frame cross beams of the bogie frame and configured to travel on a track, wherein

a pair of flexible traction rods arranged along the vehicle longitudinal direction and configured to be capable of extending and retracting in the vehicle longitudinal direction are provided in the bogie, the pair of flexible traction rods are arranged spaced apart from each other in a vehicle lateral direction, one end of each of the flexible traction rods is attached to the bogie frame cross beams, and the other end of each of the flexible traction rods is attached to a receiving section provided in the vehicle body, and

the bogie is configured to be capable of turning with respect to the vehicle body.

[Claim 2]

A low floor vehicle comprising:

a bogie provided under a vehicle body;

a bogie frame configured as a frame member of the bogie;

a pair of bogie frame cross beams arranged along a vehicle lateral direction in a middle of a vehicle longitudinal direction of the bogie frame and arranged spaced apart from each other in the vehicle longitudinal direction; and

a pair of wheels provided in each of a vehicle front direction and a vehicle rear direction with respect to the pair of bogie frame cross beams of the bogie frame and configured to travel on a track, wherein

one traction rod arranged along the vehicle longitudinal direction in the center in a vehicle lateral direction is provided in the bogie, one end of the traction rod is attached to the bogie frame cross beam, and the other end of the traction rod is attached to a receiving section provided in the vehicle body,

a restoring rod arranged along the vehicle longitudinal direction and configured to be capable of extending and retracting in the vehicle longitudinal direction is provided at at least one of left and right outer sides in the vehicle lateral direction of the traction rod, one end of the restoring rod is attached to the bogie frame cross beam, and the other end of the restoring rod is attached to the receiving section provided in the vehicle body, and

the bogie is configured to be capable of turning with respect to the vehicle body.

[Claim 3]

The low floor vehicle according to claim 1 or 2, wherein

a turn suppression damper arranged along the vehicle lateral direction and configured to be capable of attenuating force in the vehicle lateral direction is provided in each of a front direction section of the bogie frame cross beam on the vehicle front direction and a rear direction section of the bogie frame cross beam on

the vehicle rear direction, one end of the turn suppression damper is attached to the bogie frame cross beam, and the other end of the turn suppression damper is attached to the receiving section provided in the vehicle body, and

a receiving section provided in the vehicle body and a stopper member provided in the bogie are arranged to be capable of coming into contact with each other so as to regulate a turn of the vehicle body.