(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 4 484 643 A2**

(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 153(4) EPC

(43) Date of publication:
01.01.2025 Bulletin 2025/01

(21) Application number: **23745787.4**

(22) Date of filing: **03.01.2023**

(51) International Patent Classification (IPC):
E01B 25/00 *(2006.01)* ***E01B 2/00*** *(2006.01)*
E01B 5/18 *(2006.01)*

(52) Cooperative Patent Classification (CPC):
E01B 2/00

(86) International application number:
PCT/CN2023/070021

(87) International publication number:
WO 2023/142902 (03.08.2023 Gazette 2023/31)

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC ME MK MT NL NO PL PT RO RS SE SI SK SM TR

(30) Priority: **25.01.2022 US 202263303000 P**
14.04.2022 US 202263331029 P

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(54) MOTION MECHANISM OF RAILWAY AND STEEL WHEEL TYPE TRAIN

(57) A motion mechanism of steel rail track and steel wheel vehicle includes a track and a vehicle, wherein the track comprises: two main steel rails, one or two auxiliary rails, or no auxiliary rails, and a turnout; the main steel rails and the auxiliary rails form a ballastless track or a ballasted track; the vehicle comprises: a vehicle body, a main steel wheel, an auxiliary rail guide wheel, and an auxiliary rail action component; the main steel wheel has or has no wheel flange, the tread is a cylindrical surface, and the left and right main steel wheels are independent rolling wheel pairs, not rigid wheel pairs; the main steel wheel rolls on the main steel rail, supports the weight of the vehicle, and drives and brakes the vehicle. The vertical surface of the auxiliary rail or the main steel rail guides, drives and brakes the vehicle.

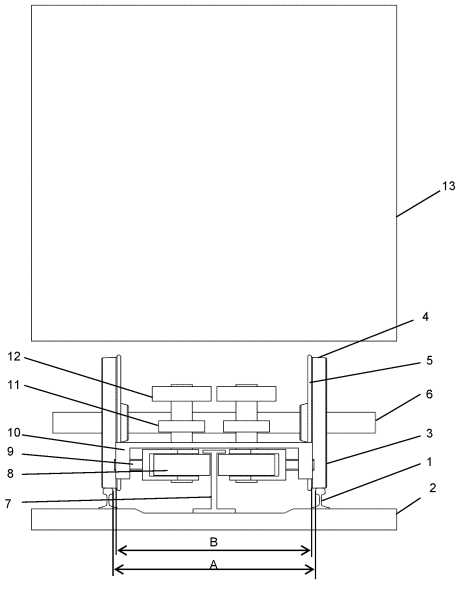

FIG. 1

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Description

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This is a continuation of International Application No. PCT/CN2023/070021 filed on January 3, 2023, which claims priority to U.S. Provisional Patent Application No. 63/303,000 filled on January 25, 2022 and U.S. Provisional Patent Application No. 63/331,029 filled on April 14, 2022. The disclosures of the above-referenced applications are hereby incorporated by reference in their entirety.

TECHNICAL FIELD

[0002] The present invention relates to a motion mechanism of steel rail track and steel wheel vehicle, which is applicable to passenger and freight rail transportation vehicles such as ordinary railways, high-speed railways, subways, and light rails.

BACKGROUND

[0003] Steel rail steel wheel vehicles are railway vehicles with flanged steel wheels rolling on two rails. They mainly include ordinary passenger and freight railways, high-speed railways, subways, and light rails. Since the invention of steam locomotives 200 years ago, they have made great contributions to the progress of human civilization. In today's social economy, steel rail steel wheel trains still play an important role and are the most widely used rail transportation. However, there are some important technical deficiencies in the current steel rail steel wheel trains, which limit the further expansion of railway train applications. For example, trains can derail. When the speed is fast, the acceleration and deceleration is large, the vibration is large, there are sharp bends, crosswinds, earthquakes, etc., if the tracks and trains are not damaged in advance, the steel wheels of the train will slide out of the rails horizontally, or the steel wheels on one side of the left and right will be lifted up, or the steel wheels on both sides of the left and right will jump up at the same time, etc., causing the train to derail and cause accidents. In addition, compared with the rubber tires and concrete pavement of cars, the friction coefficient between the rails and steel wheels of railway trains is small, which makes the driving force, braking force and centripetal force of the steel wheels of trains small, so the train accelerates slowly, brakes poorly, cannot go up steep slopes, cannot stop when going down steep slopes, and has a large turning radius, so it cannot compete with cars in many aspects. Although the rack railway can go up and down steep slopes, it is slow and consumes a lot of energy on flat ground, so it is not popular. The present invention improves the track and vehicle structure of the steel rail and steel wheel, adopts the structure of vehicle hugging track or track hugging vehicle, so that the train cannot derail if the track and train are not damaged in advance. Solving the problem of train derailment, it is possible to increase the driving force of the train, reduce the weight of the train, and obtain a higher speed, such as 600 kilometers per hour, that is, more than 600km/h. The Shanghai maglev train, the roller coaster in the amusement park, and the rocket sled railway vehicle all adopt the structure of vehicle hugging track and do not derail. The Shanghai maglev train can reach a speed of 430 kilometers per hour. The roller coaster can roll, twist, go up and down steeply, and make sharp turns. The rocket sled railway vehicle ran at a speed of 10,000 kilometers per hour, about 8.5 times the speed of sound, at Holloman Air Force Base in New Mexico, USA in 2003. It is the fastest vehicle on the surface of the earth and is a steel rail transit. However, the Shanghai Maglev railway vehicle is not suitable for heavy-load freight, such as transporting coal, ore, or cement. Roller coasters are not suitable for long-distance passenger and freight transportation. The rocket sled railway vehicle uses a rocket engine, which is noisy and not suitable for use in cities. Moreover, the track is limited to straight lines and cannot have curves, and it cannot travel long distances or heavy-load freight. The present invention is improved on the basis of the steel rail and steel wheel trains of existing ordinary passenger and freight railways, high-speed railways, subways, and light rails to obtain non-derailment performance. Further structural improvements enable trains to obtain more powerful driving force, more powerful braking force, and more powerful guiding force than cars with rubber tires rolling on asphalt or concrete roads, so that the trains obtain more powerful rapid acceleration, rapid deceleration, rapid uphill, rapid downhill, and sharp turning performance than cars, which is suitable for high-speed passenger transportation and heavy-load freight. In addition, several simple and practical turnouts with high-speed passing performance have been invented, which are conducive to the establishment of a large-scale railway network. The existing high-speed railway is improved on the basis of the earlier ordinary railway, and the vehicle speed has been greatly improved. However, ordinary railways can carry heavy-loaded freight, but high-speed railways cannot, because heavy-loaded freight trains will damage the tracks of high-speed railways, but will not damage the tracks of ordinary railways. Ordinary railways can make small-radius turns, so it is easy to build a large number of subways in urban areas where land acquisition is difficult. However, high-speed railways cannot make small-radius turns, so it is more difficult to pass through urban areas where land acquisition is difficult. Therefore, compared with ordinary railways, the speed of high-speed railways has increased, but heavy-loaded freight and subway passenger transportation have been lost. Therefore, high-speed railways are not improved and upgraded versions of ordinary railways. They are two different railways. High-speed railways cannot replace ordinary railways and cannot eliminate ordinary railways. Both high-speed railways and ordinary railways require a large amount of land

resources, which is very wasteful. In existing high-speed railways and ordinary railways, vehicles use conical tread wheels for guidance, which are simple in structure and low in cost, but they also inevitably produce hunting oscillation, resulting in poor running performance and limited business. The present invention adopts cylindrical tread wheels and adds horizontal guide wheels for guidance. It unifies high-speed railways and ordinary railways, so that the occupied land resources may be reduced by half. In addition, the present invention shortens the braking distance of high-speed railways and ordinary railways to a shorter distance than the braking distance of automobiles on asphalt roads and concrete roads, which can enable railway vehicles to perform unmanned automatic driving in large quantities, changing the competitive relationship with automobiles.

SUMMARY

[0004] Based on the existing steel rails and steel wheels of high-speed railways and ordinary railways, the present invention adds auxiliary rails on the track, and cooperates with it to add derailment prevention claws on the train, so that the structure of the vehicle hugging the rails, that is, the rail holding structure, or the structure of the rail hugging the vehicle, that is, the vehicle holding structure, prevents the train from derailing. And, the derailment prevention claws are replaced with brake pads to obtain strong braking. Further replaced with wheels, strong driving force, strong braking force, and strong guiding force are obtained. In addition, linear motor driving and braking are added between the auxiliary rails and the train to obtain non-contact. Reasonable allocation of the proportion of multiple driving and braking to achieve energy saving. The present invention changes the tread shape of the steel wheels of the existing ordinary railways and high-speed railway trains from conical surfaces to cylindrical surfaces, from rigid wheelsets to differential wheelsets, and adds horizontal guide wheels. The horizontal guide wheels roll on the vertical surface of the auxiliary rails or the main rails for strong guidance to prevent derailment. This structure makes the railway vehicle run more smoothly, the lateral vibration is smaller, the high-speed railway speed is faster, the high-speed railway track can be used for heavy-load freight, and the high-speed railway vehicle can make a smaller radius turn.

[0005] The present invention discloses the innovative structure of the main steel rail and the main steel wheel, the innovative structure of the auxiliary rail and the auxiliary rail action assembly, the innovative material, the relationship between the guiding, driving and braking of the auxiliary rail and the guiding, driving and braking of the main steel rail, the innovative structural design of the turnout, diamond crossing, level crossing, curve and so on when the auxiliary rail is provided. The contents of the present invention are as follows.

[0006] A motion mechanism of steel rail track and steel wheel vehicle of the present invention comprising:

one or both of a track and a vehicle;

wherein,

the track comprises two main steel rails, one or two auxiliary rails and a turnout, wherein the main steel rails and the auxiliary rails form a ballastless track or a ballasted track;

the vehicle comprises a vehicle body, a main steel wheel, an anti-derailment horizontal claw, wherein the main steel wheel has a wheel flange, the tread is a conical surface, and the left and right main steel wheels as well as the wheel axle form a rigid wheel pair;

and wherein,

(1) the distance between the main steel rails is a standard gauge of 1435 mm, a wide gauge greater than 1435 mm, or a narrow gauge less than 1435 mm; the joints in the length direction of the main steel rails are welded seams, oblique seams, or straight seams;

(2) The auxiliary rail is parallel to the main rail, and is one rail located in the middle of the two main rails, two rails located inside the two main rails, or two rails located outside the two main rails; The auxiliary rail has an upper wing, with or without a lower wing; the upper wing is higher than the upper surface tread of the main rail, and the lower wing and the fixing are lower than the upper surface tread of the main rail; when there is one auxiliary rail, the cross-sectional shape is an I-shaped or T-shaped; when there are two auxiliary rails, the cross-sectional shape is an I-shaped or T-shaped or other shapes; the joint in the length direction of the auxiliary rail is a welded seam, oblique seam, serrated seam, or straight seam; the auxiliary rail has or does not have a stator or rotor of a linear motor; when it has, the vehicle is equipped with a matching rotor or stator of a linear motor higher than the tread of the main rail for non-contact driving or braking;

(3) The main steel wheel is installed on the bogie under the car body, or directly on the car body when there is no bogie, rolling on the upper surface of the main steel rail to support the weight of the vehicle; the main steel wheel is a driving wheel, a brake wheel, or a driven wheel, or switches to the state of a driving wheel, a brake wheel, or a driven wheel according to control; The wheel flange and conical tread of

the main steel wheel cooperate with the main steel rail for guidance;

(4) The derailment prevention horizontal claw is installed on the bogie under the car body, or directly on the car body when there is no bogie. The horizontal claw is higher than the tread on the upper surface of the main rail and below the upper wing of the auxiliary rail; when there is one auxiliary rail, there is a pair of horizontal claws on the left and right sides of the waist of the auxiliary rail, hugging the upper wing of the auxiliary rail; when there are two auxiliary rails, there is a pair of horizontal claws, or two pairs of horizontal claws, hugging the upper wing of the auxiliary rail, or being hugged by the upper wing;

(5) In the horizontal direction, there is a certain gap between the end of the horizontal claw and the waist of the auxiliary rail, or between the root of the horizontal claw and the end of the upper wing of the auxiliary rail, and they are usually not in contact, so as not to affect the left and right swing of the vehicle caused by the cooperation and guidance of the conical tread of the main steel wheel and the main steel rail; However, the gap is not very large. When the vehicle swings left and right or moves to a large extent and may derail, the end of the horizontal claw contacts the waist of the auxiliary rail, or the root of the horizontal claw contacts the end of the upper wing of the auxiliary rail, thereby limiting the left and right movement and preventing derailment; In addition, in the vertical direction, there is a certain gap between the upper surface of the horizontal claw and the lower surface of the upper wing of the auxiliary rail, and they are usually not in contact; however, the gap is not very large. When the train jumps up or lifts up for some reason, the upper surface of the horizontal claw contacts the lower surface of the I-shaped upper wing to prevent the upward movement of the train;

(6) In the turnout section, the point rail section of the main rail is driven by the switch machine to swing left and right, and the flange of the main steel wheel cooperates with the main rail to guide and change the track; the auxiliary rail is interrupted and not laid in the turnout section; the derailment prevention horizontal claw higher than the upper surface of the main rail passes over the main rail from above without colliding with the main rail; after passing the interrupted section of the auxiliary rail, it is smoothly re-sleeved on both sides of the auxiliary rail; or the auxiliary rail also swings left and right in the turnout section, the upper wing passes over the main rail, and the derailment prevention horizontal claw is always sleeved on the upper wing of the auxiliary rail, passing over the main rail from above without colliding with the main rail, and passing through the turnout section;

(7) The main steel wheels of the vehicle can roll on the traditional standard gauge, wide gauge, or narrow gauge steel rails without auxiliary rails, and can roll over the traditional turnouts; the derailment prevention horizontal claws are above the main steel rails and will not collide with the main steel rails;

(8) The main steel rails and the turnouts can be rolled over by the steel wheels of the traditional standard gauge, wide gauge, or narrow gauge trains without anti-derailment horizontal claws; for the auxiliary rails that are higher than the upper surface of the main rails, the corresponding components under the traditional train are removed or modified so that the lower part of the train does not contact the auxiliary rails and can roll throughout the entire journey;

[0007] The said fixed end of the derailment prevention horizontal claw is replaced with a horizontal rolling wheel or a vertical rolling wheel, so that when it contacts the vertical surface of the auxiliary rail or the lower surface of the upper wing, the sliding contact is changed to rolling contact to reduce friction; the horizontal rolling wheel or the vertical rolling wheel is installed on a rigid or elastic support body and usually does not contact the vertical surface of the auxiliary rail or the lower surface of the upper wing; when the vehicle moves left and right more, or when the vehicle is lifted up more, rolling contact is made, thereby limiting the larger left and right movement or upward movement; or, the horizontal rolling wheel or the vertical rolling wheel is installed on an elastic support body, usually rolling contact with the vertical surface of the auxiliary rail or the lower surface of the upper wing, limiting the larger left and right movement or upward movement.

[0008] The said auxiliary rail is a power supply rail that provides power to the vehicle from the track.

[0009] A motion mechanism of steel rail track and steel wheel vehicle of the present invention comprising:

one or both of a track and a vehicle;

wherein,

the track comprises two main steel rails, one or two auxiliary rails and a turnout, wherein the main steel rails and the auxiliary rails form a ballastless track or a ballasted track;

the vehicle comprises a vehicle body, a main steel

wheel, and an auxiliary rail action assembly, wherein the main steel wheel have a wheel flange, the tread is a conical surface, and the left and right main steel wheels as well as the wheel axle form a rigid wheel pair; the auxiliary rail action component is one or more of the following: 1) horizontal auxiliary wheels, 2) auxiliary rail brake pads, 3) auxiliary rail brake pads plus buffer wheels, 4) linear eddy current brake components, 5) rotors or stators of vehicle linear motors;

and wherein,

(1) the distance between the main steel rails is a standard gauge of 1435 mm, a wide gauge greater than 1435 mm, or a narrow gauge less than 1435 mm; the joints in the length direction of the main steel rails are welded seams, oblique seams, or straight seams;

(2) The auxiliary rail is parallel to the main rail, and is one rail located in the middle of the two main rails, two rails located inside the two main rails, or two rails located outside the two main rails; the cross-sectional shape of the auxiliary rail is an I-shaped or T-shaped rail, with an upper wing and a waist, and the left and right vertical surfaces of the waist are auxiliary rail treads, with or without lower wings; the auxiliary rail tread is higher than the tread on the upper surface of the main rail, and the lower wing and the fixing are lower than the tread on the upper surface of the main rail; the tread material of the auxiliary rail is an iron alloy or a wear-resistant material of artificial stone; the joints in the length direction of the auxiliary rail are welded seams, oblique seams, serrated seams, or straight seams; the auxiliary rail has or does not have a stator or rotor of a linear motor;

(3) The main steel wheel is installed on the bogie under the car body, or directly on the car body when there is no bogie, rolling on the upper surface of the main steel rail to support the weight of the vehicle; the main steel wheel is a driving wheel, a brake wheel, or a driven wheel, or switches to the state of a driving wheel, a brake wheel, or a driven wheel according to control; The wheel flange and conical tread of the main steel wheel cooperate with the main steel rail for guidance;

(4) The auxiliary rail action assembly are installed on the bogie under the car body, or directly installed on the car body when there is no bogie, higher than the main rail tread; the horizontal auxiliary wheel, auxiliary rail brake pad and auxiliary rail brake pad plus buffer wheel are auxiliary rail contact components; the left and right auxiliary rail contact components become a pair, forming an auxiliary rail contact component pair; the auxiliary rail contact component pair is squeezed on the auxiliary rail tread from the left and right through a pneumatic piston, a hydraulic piston, an electromagnetic piston, or a magnetic attraction drive, and does not support the weight of the vehicle; the extrusion force and release of the auxiliary rail contact component pair can be controlled and adjusted when the train is running; the horizontal auxiliary wheel is a driving wheel, a brake wheel, or a driven wheel, or according to the control, it switches to the state of driving wheel, brake wheel, or driven wheel; the horizontal auxiliary wheels roll on the friction surface, not gear rolling, nor rubber tire; the tread material of the horizontal auxiliary wheel, horizontal auxiliary brake pad or horizontal buffer wheel is metal alloy, or wear-resistant material of artificial stone; the linear eddy current brake component is an auxiliary rail non-contact component, which is installed above the auxiliary rail and acts on the auxiliary rail upper wing for non-contact braking, or the left and right linear eddy current brake components become a pair, acting on the auxiliary rail tread and nearby from the left and right for non-contact braking; when the auxiliary rail has a stator or rotor of a linear motor, a matching linear motor rotor or stator higher than the main rail tread is installed on the vehicle for non-contact driving and braking;

(5) When the driving or braking motive force of the horizontal auxiliary wheel pair is small, the squeezing force of the horizontal auxiliary wheel pair is also small; when the driving or braking motive force of the horizontal auxiliary wheel pair is large, the squeezing force of the horizontal auxiliary wheel pair is also large; in order to avoid excessive squeezing force when the motive force is small, resulting in large friction resistance; and to avoid too small squeezing force when the motive force is large, resulting in the horizontal auxiliary wheel slipping when rolling on the auxiliary rail tread; between the auxiliary rail brake pad pair and the auxiliary rail, there is sliding friction braking, and the magnitude of the braking force is directly controlled by adjusting the magnitude of squeezing force;

(6) The auxiliary rail action assembly is not guided under normal operation; when the auxiliary rail is squeezed from the left and right, the auxiliary rail contact assembly pair moves freely left and right relative to the main steel wheel of the vehicle so as not to affect the matching

guidance of the conical tread of the main steel wheel and the main rail; however, the amount of free movement left and right is not large. When the train swings left and right or moves greatly and may derail, the left and right movement is limited, thereby preventing left and right derailment; its overall left and right movement mechanism is: 1) The auxiliary rail contact assembly pair is installed as a whole on a guide rail that can slide freely left and right; 2) The auxiliary rail contact assembly pair is installed as a whole on a rotating shaft or circular hole that can rotate freely left and right; 3) The auxiliary rail contact assembly pair is simultaneously controlled by the same air pressure pipeline, the same hydraulic pipeline or the piston of the motor, or magnetic attraction , driving to squeeze the auxiliary rail from left and right; the pneumatic pipeline, hydraulic pipeline or motor, or magnetic attraction, only controls the squeezing force or release of the auxiliary rail contact assembly pair, and at the same time allows the auxiliary rail contact assembly pair to move freely in the left and right directions as a whole; in addition, in the vertical direction, there is a certain gap between the upper surface of the auxiliary rail contact assembly and the lower surface of the auxiliary rail upper wing, and they are usually not in contact; but the gap is not very large. When the train jumps up or lifts up for some reason, the upper surface of the auxiliary rail contact assembly contacts the lower surface of the I-shaped upper wing to prevent the train from derailing upward; the linear eddy current brake assembly and the rotor or stator of the vehicle linear motor have or do not have the overall free movement left and right, which does not affect the matching guidance of the conical tread of the main steel wheel and the main steel rail;

(7) In the turnout section, the point rail section of the main rail is driven by the switch machine to swing left and right, and the flange of the main steel wheel cooperates with the main rail to guide and change the track; the auxiliary rail is interrupted and not laid in the turnout section. The auxiliary rail contact assembly pair that is higher than the upper surface of the main rail passes over the main rail from above without colliding with the main rail. When passing through the interrupted section of the auxiliary rail, it is opened without squeezing or has a trumpet shape, so that after passing through the interrupted section of the auxiliary rail, it can be smoothly re-sleeved on both sides of the auxiliary rail; or the auxiliary rail also swings left and right in the turnout section, the auxiliary rail tread passes over the main rail, the auxiliary rail contact assembly pair is always sleeved on both sides of the auxiliary rail tread, passes over the main rail from above without colliding with the main rail, and passes through the turnout section; the linear eddy current brake assembly and the rotor or stator of the vehicle linear motor pass over the main rail from above without colliding with the main rail and pass through the turnout section;

(8) The driving or braking of the vehicle, including the driving or braking of the main rail and the driving or braking of the auxiliary rail; wherein, the driving or braking of the auxiliary rail includes one or more of the following: 1) the driving or braking of the horizontal auxiliary wheel of the auxiliary rail, 2) the braking of the auxiliary rail brake pad, 3) the braking of the linear eddy current brake assembly of the auxiliary rail, 4) the driving or braking of the linear motor of the auxiliary rail; the driving or braking of the main rail and the auxiliary rail adopts or does not adopt the following distribution: 1) when the driving force or braking force required by the vehicle is small, or the driving or braking of the main rail and the main steel wheel is sufficient, only the driving or braking of the main rail and the main steel wheel is used; 2) When the driving force or braking force required by the vehicle is large, or the driving or braking of the main rail and the main steel wheel is insufficient, the vehicle uses the driving or braking of the main rail and the auxiliary rail at the same time, or only uses the driving or braking of the auxiliary rail;

(9) The main steel wheels of the vehicle can roll on the standard gauge, wide gauge, or narrow gauge steel rails of the traditional railways without auxiliary rails, and can roll over the traditional turnouts; the auxiliary rail action assemblies are above the traditional steel rails and will not collide with the steel rails;

(10) The main steel rails and the turnouts can be rolled over by the steel wheels of the traditional standard gauge, wide gauge, or narrow gauge trains without auxiliary rail action assemblies; for the auxiliary rails that are higher than the upper surface of the main rails, the corresponding components under the traditional train are removed or modified so that the lower part of the train does not contact the auxiliary rails and can roll throughout the entire journey;

[0010] A motion mechanism of steel rail track and steel wheel vehicle of the present invention comprising:

one or both of a track and a vehicle;

wherein,

the track comprises two main steel rails, one or two auxiliary rails and a turnout, wherein the main steel rails are flat-topped rails, and the main steel rails and the auxiliary rails form a ballastless track or a ballasted track;

the vehicle comprises a vehicle body, a main steel wheel, an auxiliary rail guide wheel and an auxiliary rail action assembly, wherein the main steel wheel does not have a wheel flange, the tread is a cylindrical surface, and the left and right main steel wheels are independent rolling wheel pairs, not rigid wheel pairs; the auxiliary rail action component is one or more of the following: 1) horizontal auxiliary wheels, 2) auxiliary rail brake pads, 3) auxiliary rail brake pads plus buffer wheels, 4) linear eddy current brake components, 5) rotors or stators of vehicle linear motors;

and wherein,

(1) the distance between the main steel rails is a standard gauge of 1435 mm, a wide gauge greater than 1435 mm, or a narrow gauge less than 1435 mm; the joints in the length direction of the main steel rails are welded seams, oblique seams, serrated seams, or straight seams;

(2) The auxiliary rail is parallel to the main rail, and is one rail located in the middle of the two main rails, two rails located inside the two main rails, or two rails located outside the two main rails; the cross-sectional shape of the auxiliary rail is an I-shaped or T-shaped rail, with an upper wing and a waist, and the left and right vertical surfaces of the waist are auxiliary rail treads, with or without lower wings; the auxiliary rail tread is higher than the tread on the upper surface of the main rail, and the lower wing and the fixing are lower than the tread on the upper surface of the main rail; the tread material of the auxiliary rail is an iron alloy or a wear-resistant material of artificial stone; the joints in the length direction of the auxiliary rail are welded seams, oblique seams, serrated seams, or straight seams; the auxiliary rail has or does not have a stator or rotor of a linear motor;

(3) The main steel wheel is installed on the bogie under the car body, or directly on the car body when there is no bogie, rolling on the upper surface of the main steel rail to support the weight of the vehicle; the main steel wheel is a driving wheel, a brake wheel, or a driven wheel, or switches to the state of a driving wheel, a brake wheel, or a driven wheel according to control; in normal operation of the straight and curved sections outside the turnout, diamond intersection, and crossing, the wheel flange of the main steel wheel is not guided;

(4) The auxiliary rail guide wheel and auxiliary rail action assembly are installed on the bogie under the car body, or directly installed on the car body when there is no bogie, higher than the main rail tread; the left and right auxiliary rail guide wheels become a pair, forming an auxiliary rail guide wheel pair, which guides on both sides of the auxiliary rail tread; the horizontal auxiliary wheel, auxiliary rail brake pad and auxiliary rail brake pad plus buffer wheel are auxiliary rail contact components; the left and right auxiliary rail contact components become a pair, forming an auxiliary rail contact component pair; the auxiliary rail contact component pair is squeezed on the auxiliary rail tread from the left and right through a pneumatic piston, a hydraulic piston, an electromagnetic piston, or a magnetic attraction drive, and does not support the weight of the vehicle; the extrusion force and release of the auxiliary rail contact component pair can be controlled and adjusted when the train is running; the horizontal auxiliary wheel is a driving wheel, a brake wheel, or a driven wheel, Or according to the control, it switches to the state of driving wheel, brake wheel, or driven wheel; the auxiliary rail guide wheel and horizontal auxiliary wheel roll on the friction surface, not gear rolling, nor rubber tire; the tread material of the auxiliary rail guide wheel, horizontal auxiliary wheel, horizontal auxiliary brake pad or horizontal buffer wheel is metal alloy, or wear-resistant material of artificial stone; the tread width of the auxiliary rail guide wheel and the auxiliary rail contact component is greater than 20mm; the linear eddy current brake component is an auxiliary rail non-contact component, which is installed above the auxiliary rail and acts on the auxiliary rail upper wing for non-contact braking, or the left and right linear eddy current brake components become a pair, acting on the auxiliary rail tread and nearby from the left and right for non-contact braking; when the auxiliary rail has a stator or rotor of a linear motor, a matching linear motor rotor or stator higher than the main rail tread is installed on the vehicle for non-contact driving and braking;

(5) When the driving or braking motive force of the horizontal auxiliary wheel pair is small, the squeezing force of the horizontal auxiliary wheel pair is also small; when the driving or braking motive force of the horizontal auxiliary wheel pair is large, the squeezing force of the horizon-

tal auxiliary wheel pair is also large; in order to avoid excessive squeezing force when the motive force is small, resulting in large friction resistance; and to avoid too small squeezing force when the motive force is large, resulting in the horizontal auxiliary wheel slipping when rolling on the auxiliary rail tread; between the auxiliary rail brake pad pair and the auxiliary rail, there is sliding friction braking, and the magnitude of the braking force is directly controlled by adjusting the magnitude of squeezing force;

(6) The auxiliary rail guide wheel pair guides under normal operation; when the auxiliary rail guide wheel pair or the auxiliary rail contact assembly pair guides or squeezes the auxiliary rail from left to right, relative to the main steel wheel of the vehicle, there is no left-right movement as a whole, or there is a small left-right movement, so as to absorb the straightness tolerance of the auxiliary rail laying, avoid the interference of the guiding or squeezing fit in the straight section with the inertial linear motion of the train, and make the train movement more stable; its overall left-right movement mechanism is: 1) The auxiliary rail guide wheel pair or the auxiliary rail contact assembly pair is installed as a whole on a guide rail that can slide freely left and right; 2) The auxiliary rail guide wheel pair or the auxiliary rail contact assembly pair is installed as a whole on a rotating shaft or circular hole that can rotate freely left and right; 3) The auxiliary rail guide wheel pair or the auxiliary rail contact assembly pair is driven by the same pneumatic pipeline, the same hydraulic pipeline or the piston of the motor, or magnetic attraction, to squeeze the auxiliary rail from left to right; the pneumatic pipeline, the hydraulic pipeline or motor, or magnetic attraction, only controls the squeezing force or release of the auxiliary rail guide wheel pair or the auxiliary rail contact assembly pair, and at the same time allows the auxiliary rail guide wheel pair or the auxiliary rail contact assembly pair to move freely in the left and right directions as a whole; or, the auxiliary rail guide wheel is fixed on a spring or a spring plate, and has a small left and right movement as a whole, so as to reduce the interference of the guide matching in the straight section with the inertial linear motion of the train; the linear eddy current brake assembly has or does not have the overall left and right free movement, which does not affect the matching guide of the auxiliary rail guide wheel and the auxiliary rail; in addition, in the vertical direction, there is a certain gap between the upper surface of the auxiliary rail guide wheel or the auxiliary rail contact assembly and the lower surface of the upper wing of the auxiliary rail, and they are usually not in contact; but the gap is not very large, when the train jumps up or lifts up for some reason, the upper surface of the auxiliary rail guide wheel or the auxiliary rail contact assembly contacts the lower surface of the upper wing to prevent the train from derailing upwards;

(7) In the turnout section, the point rail section of the main rail is driven by the switch machine to swing left and right, and the wheel flange of the main steel wheel cooperates with the main rail for guidance to change the track; the auxiliary rail is interrupted and not laid in the turnout section, and the auxiliary rail guide wheel pair and the auxiliary rail contact assembly pair that are higher than the upper surface of the main rail pass over the main rail from above without colliding with the main rail. When passing through the interrupted section of the auxiliary rail, they are opened without squeezing or have a flared shape so that after passing through the interrupted section of the auxiliary rail, they can be smoothly re-mounted on both sides of the auxiliary rail; or the auxiliary rail also swings left and right in the turnout section, and the auxiliary rail tread passes over the main rail. The auxiliary rail guide wheel pair and the auxiliary rail contact assembly pair are always mounted on both sides of the auxiliary rail tread, pass over the main rail from above without colliding with the main rail, and pass through the turnout section. In the turnout section, the auxiliary rail guide wheel is not guided;

(8) The driving or braking of the vehicle, including the driving or braking of the main rail and the driving or braking of the auxiliary rail; wherein, the driving or braking of the auxiliary rail includes one or more of the following: 1) the driving or braking of the horizontal auxiliary wheel of the auxiliary rail, 2) the braking of the auxiliary rail brake pad, 3) the braking of the linear eddy current brake assembly of the auxiliary rail, 4) the driving or braking of the linear motor of the auxiliary rail; the driving or braking of the main rail and the auxiliary rail adopts or does not adopt the following distribution: 1) when the driving force or braking force required by the vehicle is small, or the driving or braking of the main rail and the main steel wheel is sufficient, only the driving or braking of the main rail and the main steel wheel is used; 2) When the driving force or braking force required by the vehicle is large, or the driving or braking of the main rail and the main steel wheel is insufficient, the vehicle uses the driving or braking of the main rail and the auxiliary rail at the same time, or only uses the

driving or braking of the auxiliary rail;

(9) The main steel wheels of the vehicle can roll on the standard gauge, wide gauge, or narrow gauge steel rails of the traditional railways without auxiliary rails, and can roll over the traditional turnouts; the auxiliary rail guide wheels and auxiliary rail action assemblies are above the traditional steel rails and will not collide with the steel rails;

(10) The main steel rails and the turnouts can be rolled over by the steel wheels of the traditional standard gauge, wide gauge, or narrow gauge trains without auxiliary rail guide wheels and auxiliary rail action assemblies; for the auxiliary rails that are higher than the upper surface of the main rails, the corresponding components under the traditional train are removed or modified so that the lower part of the train does not contact the auxiliary rails and can roll throughout the entire journey;

(11) The auxiliary rail guide wheels and horizontal auxiliary wheels are two different wheels, or two functional states of the same wheel.

[0011] The said diamond intersection or crossing section, the main steel rail has no movable part, and the auxiliary rail is interrupted and not laid; the auxiliary rail guide wheel pair or the auxiliary rail contact assembly pair, when passing through the auxiliary rail interruption section, is opened without clamping or has a trumpet shape, so that after passing through the auxiliary rail interruption section, it can be smoothly re-sleeved on both sides of the auxiliary rail; the conical tread or wheel flange of the main steel wheel cooperates with the main steel rail to guide, so that the auxiliary rail guide wheel pair or the auxiliary rail contact assembly pair can smoothly pass through the diamond intersection or crossing section. The said vertical rolling wheel is mounted on the bogie under the car body, or directly mounted on the car body when there is no bogie, located below the upper wing of the auxiliary rail and higher than the main steel rail tread; the vertical rolling wheel is mounted on a rigid or elastic support body and usually does not contact the lower surface of the upper wing of the auxiliary rail; when the vehicle is lifted upward to a large extent, rolling contact is made, thereby limiting a large upward movement; or, the vertical rolling wheel is mounted on an elastic support body, usually rolling contact with the lower surface of the upper wing of the auxiliary rail, limiting a large upward movement.

[0012] A motion mechanism of steel rail track and steel wheel vehicle of the present invention comprising:

one or both of a track and a vehicle;

wherein,

the track comprises two main steel rails, one or two auxiliary rails and a turnout, wherein the main steel rails and the auxiliary rails form a ballastless track or a ballasted track;

the vehicle comprises a vehicle body, a main steel wheel, an auxiliary rail guide wheel and an auxiliary rail action assembly, wherein the main steel wheel does not have a wheel flange, the tread is a cylindrical surface, and the left and right main steel wheels are independent rolling wheel pairs, not rigid wheel pairs; the auxiliary rail action component is one or more of the following: 1) horizontal auxiliary wheels, 2) auxiliary rail brake pads, 3) auxiliary rail brake pads plus buffer wheels, 4) linear eddy current brake components, 5) rotors or stators of vehicle linear motors;

and wherein,

(1) the distance between the main steel rails is a standard gauge of 1435 mm, a wide gauge greater than 1435 mm, or a narrow gauge less than 1435 mm; the joints in the length direction of the main steel rails are welded seams, oblique seams, serrated seams, or straight seams;

(2) The auxiliary rail is parallel to the main rail, and is one rail located in the middle of the two main rails, two rails located inside the two main rails, or two rails located outside the two main rails; the cross-sectional shape of the auxiliary rail is an I-shaped or T-shaped rail, with an upper wing and a waist, and the left and right vertical surfaces of the waist are auxiliary rail treads, with or without lower wings; the upper wing is higher than the tread on the upper surface of the main rail, and the lower wing and the fixing are lower than the tread on the upper surface of the main rail; the tread material of the auxiliary rail is an iron alloy or a wear-resistant material of artificial stone; the joints in the length direction of the auxiliary rail are welded seams, oblique seams, serrated seams, or straight seams; the auxiliary rail has or does not have a stator or rotor of a linear motor;

(3) The main steel wheel is installed on the bogie under the car body, or directly on the car body when there is no bogie, rolling on the upper surface of the main steel rail to support the weight of the vehicle; the main steel wheel is a driving wheel, a brake wheel, or a driven wheel, or switches to the state of a driving wheel, a brake wheel, or a driven wheel according to control;

(4) The auxiliary rail guide wheel and auxiliary rail action assembly are installed on the bogie under the car body, or directly installed on the car body when there is no bogie, higher than the main rail tread; the left and right auxiliary rail guide wheels become a pair, forming an auxiliary rail guide wheel pair, which guides on both sides of the auxiliary rail tread; the horizontal auxiliary wheel, auxiliary rail brake pad and auxiliary rail brake pad plus buffer wheel are auxiliary rail contact components; the left and right auxiliary rail contact components become a pair, forming an auxiliary rail contact component pair; the auxiliary rail contact component pair is squeezed on the auxiliary rail tread from the left and right through a pneumatic piston, a hydraulic piston, an electromagnetic piston, or a magnetic attraction drive, and does not support the weight of the vehicle; the extrusion force and release of the auxiliary rail contact component pair can be controlled and adjusted when the train is running; the horizontal auxiliary wheel is a driving wheel, a brake wheel, or a driven wheel, Or according to the control, it switches to the state of driving wheel, brake wheel, or driven wheel; the auxiliary rail guide wheel and horizontal auxiliary wheel roll on the friction surface, not gear rolling, nor rubber tire; the tread material of the auxiliary rail guide wheel, horizontal auxiliary wheel, horizontal auxiliary brake pad or horizontal buffer wheel is metal alloy, or wear-resistant material of artificial stone; the tread width of the auxiliary rail guide wheel and the auxiliary rail contact component is greater than 20mm; the linear eddy current brake component is an auxiliary rail non-contact component, which is installed above the auxiliary rail and acts on the auxiliary rail upper wing for non-contact braking, or the left and right linear eddy current brake components become a pair, acting on the auxiliary rail tread and nearby from the left and right for non-contact braking; when the auxiliary rail has a stator or rotor of a linear motor, a matching linear motor rotor or stator higher than the main rail tread is installed on the vehicle for non-contact driving and braking;

(5) When the driving or braking motive force of the horizontal auxiliary wheel pair is small, the squeezing force of the horizontal auxiliary wheel pair is also small; when the driving or braking motive force of the horizontal auxiliary wheel pair is large, the squeezing force of the horizontal auxiliary wheel pair is also large; in order to avoid excessive squeezing force when the motive force is small, resulting in large friction resistance; and to avoid too small squeezing force when the motive force is large, resulting in the horizontal auxiliary wheel slipping when rolling on the auxiliary rail tread; between the auxiliary rail brake pad pair and the auxiliary rail, there is sliding friction braking, and the magnitude of the braking force is directly controlled by adjusting the magnitude of squeezing force;

(6) The auxiliary rail guide wheel pair guides under normal operation; when the auxiliary rail guide wheel pair or the auxiliary rail contact assembly pair guides or squeezes the auxiliary rail from left to right, relative to the main steel wheel of the vehicle, there is no left-right movement as a whole, or there is a small left-right movement, so as to absorb the straightness tolerance of the auxiliary rail laying, avoid the interference of the guiding or squeezing fit in the straight section with the inertial linear motion of the train, and make the train movement more stable; its overall left-right movement mechanism is: 1) The auxiliary rail guide wheel pair or the auxiliary rail contact assembly pair is installed as a whole on a guide rail that can slide freely left and right; 2) The auxiliary rail guide wheel pair or the auxiliary rail contact assembly pair is installed as a whole on a rotating shaft or circular hole that can rotate freely left and right; 3) The auxiliary rail guide wheel pair or the auxiliary rail contact assembly pair is driven by the same pneumatic pipeline, the same hydraulic pipeline or the piston of the motor, or magnetic attraction, to squeeze the auxiliary rail from left to right; the pneumatic pipeline, the hydraulic pipeline or motor, or magnetic attraction, only controls the squeezing force or release of the auxiliary rail guide wheel pair or the auxiliary rail contact assembly pair, and at the same time allows the auxiliary rail guide wheel pair or the auxiliary rail contact assembly pair to move freely in the left and right directions as a whole; or, the auxiliary rail guide wheel is fixed on a spring or a spring plate, and has a small left and right movement as a whole, so as to reduce the interference of the guide matching in the straight section with the inertial linear motion of the train; the linear eddy current brake assembly has or does not have the overall left and right free movement, which does not affect the matching guide of the auxiliary rail guide wheel and the auxiliary rail; in addition, in the vertical direction, there is a certain gap between the upper surface of the auxiliary rail guide wheel or the auxiliary rail contact assembly and the lower surface of the upper wing of the auxiliary rail, and they are usually not in contact; but the gap is not very large, when the train jumps up or lifts up for some reason, the upper surface of the auxiliary rail guide wheel or the auxiliary rail contact assem-

bly contacts the lower surface of the upper wing to prevent the train from derailing upwards;

(7) In the turnout section, the main rail has a fixed divergence point and frog, no movable parts, no movable point rail, no movable frog, and no gap greater than 10 mm on the upper tread of the main rail;

(8) The driving or braking of the vehicle, including the driving or braking of the main rail and the driving or braking of the auxiliary rail; wherein, the driving or braking of the auxiliary rail includes one or more of the following: 1) the driving or braking of the horizontal auxiliary wheel of the auxiliary rail, 2) the braking of the auxiliary rail brake pad, 3) the braking of the linear eddy current brake assembly of the auxiliary rail, 4) the driving or braking of the linear motor of the auxiliary rail; the driving or braking of the main rail and the auxiliary rail adopts or does not adopt the following distribution: 1) when the driving force or braking force required by the vehicle is small, or the driving or braking of the main rail and the main steel wheel is sufficient, only the driving or braking of the main rail and the main steel wheel is used; 2) When the driving force or braking force required by the vehicle is large, or the driving or braking of the main rail and the main steel wheel is insufficient, the vehicle uses the driving or braking of the main rail and the auxiliary rail at the same time, or only uses the driving or braking of the auxiliary rail;

(9) If the cylindrical tread main steel wheel without a wheel flange of the vehicle is equipped with a guide steel wheel with an inner wheel flange near the main steel wheel to roll on the upper surface of the main steel rail for guidance, or a horizontal guide wheel is equipped with a guide wheel to roll on the inner surface of the main steel rail for guidance, the vehicle can roll on a conventional steel rail with a standard gauge, a wide gauge, or a narrow gauge without an auxiliary rail, and can roll over a conventional turnout;

(10) The auxiliary rail guide wheels and horizontal auxiliary wheels are two different wheels, or two functional states of the same wheel.

[0013] The said turnout has a mechanism for rail left-right swing switching, and has one or more of the following track change structures: 1) The auxiliary rail has a movable section to guide the vehicle to change tracks; the movable section of the auxiliary rail is driven by the switch machine to swing left-right; the tread part of the movable end of the auxiliary rail has a protruding arm, which swings over the main rail from above the main rail and is connected to the tread part of the fixed end of the auxiliary rail through an oblique seam or a zigzag seam, so that the auxiliary rail guide wheel pair or the auxiliary rail action component pair of the vehicle rolls over or passes through the gap of the auxiliary rail guide tread without a step difference to guide the track change; 2) Two movable auxiliary rails are higher than the upper surface of the main rails, and are driven by the switch machine to swing left and right over the main rails to guide the vehicle to change tracks; the movable end of the auxiliary rail is connected to the fixed end of the auxiliary rail by an oblique seam or a zigzag seam, so that the auxiliary rail guide wheel pair or auxiliary rail action component pair of the vehicle can roll over or pass through the gap of the auxiliary rail guide tread without step difference to guide the track change; 3) In the turnout section, the auxiliary rail is interrupted and not laid in the track change section; the auxiliary rail guide wheel pair and the auxiliary rail contact component pair are opened without squeezing when passing through the interrupted section of the auxiliary rail, so that they can be smoothly re-sleeved on both sides of the auxiliary rail after passing through the interrupted section of the auxiliary rail; horizontal track change guide wheels are installed on the outer sides of the left and right main rails of the vehicle; track change guide rails are laid in the turnout section, and the switch machine drives the track change guide rails to swing left and right, and the horizontal track change guide wheels cooperate with the track change guide rails to change tracks; 4) In the turnout section, the switch machine drives the movable section of the auxiliary rail to swing left and right; the tread part of the movable end of the auxiliary rail does not pass over the main rail from above the main rail, but is interrupted and not laid; when passing through the interrupted section of the auxiliary rail, the auxiliary rail guide wheel pair and the auxiliary rail contact assembly pair are opened without squeezing, so that after passing through the interrupted section of the auxiliary rail, they can be smoothly re-sleeved on both sides of the auxiliary rail; at this time, the horizontal track change guide wheel of the train cooperates with the fixed track change guide rail to guide the auxiliary rail guide wheel pair and the auxiliary rail contact assembly pair to smoothly pass through the interrupted section of the auxiliary rail; 5) In the turnout section, part of the main rails are replaced with rails with outer rail flanges and inner rail flanges, and the switch machine drives the movable section of the auxiliary rail to swing left and right; the tread part of the movable end of the auxiliary rail does not pass over the main rail from above the main rail, but is interrupted and not laid; the auxiliary rail guide wheel pair and the auxiliary rail contact assembly pair are opened without squeezing when passing through the auxiliary rail interruption section, so that after passing through the auxiliary rail interruption section, they can be smoothly re-mounted on both sides of the auxiliary rail; at this time,

the main steel wheels of the train are guided by the outer rail flange and inner rail flange of a rail, so that the auxiliary rail guide wheel pair and the auxiliary rail contact assembly pair can smoothly pass through the auxiliary rail interruption section; 6) In the turnout section, part of the main rail is replaced with a rail with an outer rail flange, and the switch machine drives the movable section of the auxiliary rail to swing left and right; the tread part of the movable end of the auxiliary rail does not pass over the main rail from above the main rail, but is interrupted and not laid; when the auxiliary rail guide wheel pair and the auxiliary rail contact assembly pair pass through the auxiliary rail interruption section, they are opened without squeezing, so that after passing through the auxiliary rail interruption section, they can be smoothly re-sleeved on both sides of the auxiliary rail; at this time, the main steel wheels of the train are guided by the outer rail flanges of the two rails, so that the auxiliary rail guide wheel pair and the auxiliary rail contact assembly pair can pass through the auxiliary rail interruption section smoothly; 7) In the turnout section, outer guide rails and inner guide rails are added on both sides of some main rail sections, and the switch machine drives the movable section of the auxiliary rail to swing left and right; the tread part of the movable end of the auxiliary rail does not pass over the main rail from above the main rail, but is interrupted and not laid; when the auxiliary rail guide wheel pair and the auxiliary rail contact assembly pair pass through the auxiliary rail interruption section, they are opened without squeezing, so that after passing through the auxiliary rail interruption section, they can be smoothly re-sleeved on both sides of the auxiliary rail; at this time, the main steel wheels of the train are guided by the outer guide rails and the inner guide rails on both sides of a main steel rail, so that the auxiliary rail guide wheel pair and the auxiliary rail contact assembly pair can smoothly pass through the auxiliary rail interruption section; 8) In the turnout section, some main rail sections are added with outer guide rails, and the switch machine drives the movable section of the auxiliary rail to swing left and right; The tread part of the movable end of the auxiliary rail does not pass over the main rail from above, but is interrupted and not laid; when the auxiliary rail guide wheel pair and the auxiliary rail contact assembly pair pass through the auxiliary rail interruption section, they are opened without squeezing, so that after passing through the auxiliary rail interruption section, they can be smoothly re-sleeved on both sides of the auxiliary rail; at this time, the main steel wheels of the train are guided by the outer guide rails of the two rails, so that the auxiliary rail guide wheel pair and the auxiliary rail contact assembly pair can pass through the auxiliary rail interruption section smoothly.

[0014] In the said turnout section, the track does not have a mechanism for rail left-right swing switching, and the train vehicle has a movable track-changing guide wheel, which performs steering operation to achieve track changing, and its structure is one or more of the following: 1) In the turnout section, there is a track-changing guide rail installed on the ground and fixed, and the vehicle or vehicle bogie has a track-changing guide wheel, which switches up and down, and cooperates with the track-changing guide rail to guide or separate, so that the vehicle changes track; 2) In the turnout section, there is a track-changing guide rail installed on the ground and fixed, and the vehicle or vehicle bogie has a track-changing guide wheel, which switches left-right horizontal movement, and cooperates with the track-changing guide rail to guide or separate, so that the vehicle changes track; 3) In the turnout section, there is a track-changing guide wall installed on the ground and fixed, the main steel rail has a rail flange or inner and outer guide rails, and the vehicle or vehicle bogie has a track-changing guide wheel, which switches left-right horizontal movement, and cooperates with the track-changing guide wall to guide or separate, and the main steel wheel cooperates with the rail flange or inner and outer guide rails for guidance, so that the vehicle changes track;

In the said diamond intersection section, the following structure is used: 1) the main rail has no movable part, and the auxiliary rail is rotatable; when switching, the tread part of the movable end of the auxiliary rail has an extended arm, which passes over the main rail from above the main rail and is connected to the tread part of the fixed end of the auxiliary rail through an oblique seam or a zigzag seam, so that the auxiliary rail guide wheel pair of the vehicle rolls through the gap of the auxiliary rail guide tread without step difference for guidance; or, 2) both the main rail and the auxiliary rail have no movable parts; in the diamond intersection section, the auxiliary rail is interrupted and not laid; when the auxiliary rail guide wheel pair and the auxiliary rail contact assembly pair pass through the auxiliary rail interruption section, they are opened without squeezing, so that after passing through the auxiliary rail interruption section, they can be smoothly re-sleeved on both sides of the auxiliary rail; the main rail has an outer guide rail or an inner guide rail, or the main rail becomes a rail with an outer rail flange or an inner rail flange, and the guide rail or rail flange cooperates with the main steel wheel to guide the auxiliary rail guide wheel pair and the auxiliary rail contact assembly pair to pass through the diamond intersection section smoothly.

[0015] In the said crossing section, the main rail and the auxiliary rail have no movable parts; the auxiliary rail is interrupted and not laid; when passing through the interrupted section of the auxiliary rail, the auxiliary rail guide wheel pair and the auxiliary rail contact assembly pair are opened without squeezing, so that after passing through the interrupted section of the auxiliary rail, they can be smoothly re-fitted on both sides of the auxiliary rail; the main rail has an outer guide rail or an inner guide rail, or the main rail becomes a rail with an outer rail flange or an inner rail flange, and the guide rail or rail flange guides the main steel wheel, so that the auxiliary rail guide wheel pair and the auxiliary rail contact assembly pair can pass through the crossing section smoothly.

[0016] The said train vehicle is provided with a steering lever or a steering wheel to operate the main steel wheels to go straight or turn on the main steel rails or on the ground outside the rails. The said vertical rolling wheel is mounted on the bogie under the vehicle body, or directly on the vehicle body when there is no bogie, located below the upper wing of the auxiliary rail and higher than the main rail tread; the vertical rolling wheel is mounted on a rigid or elastic support body and usually does not contact the lower surface of the upper wing of the auxiliary rail; when the vehicle is lifted upward, rolling contact is made, thereby limiting the larger upward movement; or, the vertical rolling wheel is mounted on an elastic support body, usually rolling contact with the lower surface of the upper wing of the auxiliary rail, limiting the large upward movement.

[0017] A motion mechanism of steel rail track and steel wheel vehicle of the present invention comprising:

one or both of a track and a vehicle;

wherein,

the track comprises two main steel rails and a turnout, with or without a linear motor auxiliary rail, forming a ballastless track or a ballasted track;

The vehicle includes: a vehicle body, a main steel wheel without a wheel flange, and a horizontal guide wheel of the main steel rail; the tread of the main steel wheel is a conical surface, and the left and right main steel wheels and the wheel axle form a rigid wheel pair; or the tread of the main steel wheel is a cylindrical surface, and the left and right main steel wheels are independent rolling wheel pairs;

and wherein,

(1) the distance between the main steel rails is a standard gauge of 1435 mm, a wide gauge greater than 1435 mm, or a narrow gauge less than 1435 mm; the joints in the length direction of the main steel rails are welded seams, oblique seams, serrated seams, or straight seams;

(2) where the auxiliary rail has a stator or rotor of a linear motor, its upper surface shall not be lower than the tread of the main rail; accordingly, the vehicle shall be equipped with a rotor or stator of a matching linear motor that is higher than the tread of the main rail;

(3) The main steel wheel is installed on the bogie under the car body, or directly on the car body when there is no bogie, rolling on the upper surface of the main steel rail to support the weight of the vehicle; the main steel wheel is a driving wheel, a brake wheel, or a driven wheel, or switches to the state of a driving wheel, a brake wheel, or a driven wheel according to control; in normal operation of straight and curved sections outside turnouts, diamond intersections, and crossings, when the main steel wheel has a conical tread, the main steel wheel cooperates with the main steel rail for guidance; when the main steel wheel has a cylindrical tread, the horizontal guide wheel cooperates with the inner or outer tread of the main steel rail for guidance, and the main steel wheel is not guided;

(4) The main steel wheels on the vehicle and the horizontal guide wheels of the main steel rails are installed on the bogie under the vehicle body, or directly on the vehicle body when there is no bogie; the two horizontal guide wheels are located on the inner side of the two main steel rails, the outer side of the two main steel rails, and the inner and outer sides of one main steel rail; they do not support the weight of the vehicle; the horizontal guide wheels are in contact with or not in contact with the inner or outer side of the main steel rails, and roll when in contact; the tread material is a wear-resistant material such as a metal alloy or artificial stone; for the main steel wheels with cylindrical treads, the two inner horizontal guide wheels perform normal guidance and turnout track change guidance for straight and curved sections without intersections; the two inner horizontal guide wheels do not move left and right as a whole relative to the main steel wheels of the vehicle, or have a small amount of left and right movement, so as to absorb the laying straightness tolerance of the auxiliary rails, in order to avoid guidance or push in straight sections to interfere with the inertial linear motion of the train and to make the train move more smoothly; but the left and right movement amount has a limited value to prevent derailment; for the main steel wheel with conical tread, when running normally in straight and curved sections without crossing, the left and right movement is small, and the guiding force of the two inner horizontal guide wheels is less than the guiding force of the conical tread of the main steel wheel, and the main steel wheel guides; but when the left and right movement of the main steel rail increases and may derail, the two inner horizontal guide wheels do not move left and right as a whole, or have a small left and right movement but the left and right movement has a limited value, preventing derailment; in addition, at the turnout track change, the left and right movement amount of the main steel rail is large, the two inner horizontal guide wheels do not move left and right as a whole, or have a

small left and right movement amount but the left and right movement amount has a limited value, the guiding force of the horizontal guide wheel is greater than the guiding force of the conical tread of the main steel wheel, and the horizontal guide wheel guides;

(5) In the turnout section, the linear motor auxiliary rail is interrupted and not laid; the point rail section of the main rail is driven by the switch machine to swing left and right. Regardless of whether the main steel wheel has a conical tread or a cylindrical tread, the two inner horizontal guide wheels cooperate with the point rail of the main rail to guide the track change; the turnout has a fixed frog or a movable frog;

(6) The driving or braking of the vehicle, including one or more of the driving or braking of the main rails and the driving or braking of the linear motors of the auxiliary rails; the driving or braking of the main rails and the auxiliary rails, with or without the following distribution: 1) When the driving force or braking force required by the vehicle is small, or the driving or braking of the main rails and the main wheels is sufficient, only the driving or braking of the main rails and the main wheels is used; 2) When the driving force or braking force required by the vehicle is large, or the driving or braking of the main rails and the main wheels is insufficient, the vehicle uses the driving or braking of the main rails and the auxiliary rails at the same time, or only the driving or braking of the auxiliary rails is used;

(7) The main steel wheels and horizontal guide wheels of the vehicle are capable of rolling on conventional standard gauge, wide gauge, or narrow gauge steel rails with or without linear motor auxiliary rails;

(8) The main steel rails and the turnouts can be rolled over by the steel wheels of the traditional standard gauge, wide gauge, or narrow gauge trains with or without linear motor stators or rotors; for the linear motor auxiliary rails that are higher than the upper surface of the main rails, the corresponding components under the traditional train are removed or modified so that the lower part of the train does not contact the auxiliary rails and can roll throughout the entire journey;

[0018] The said track has a linear motor auxiliary rail, and the vehicle is equipped with an auxiliary rail contact assembly pair that is higher than the main rail tread; the auxiliary rail contact assembly pair is one or more of the following: 1) horizontal auxiliary wheel, 2) auxiliary rail brake pad, 3) auxiliary rail brake pad plus buffer wheel; the auxiliary rail contact assembly pair squeezes the auxiliary rail from left and right to drive, brake, or prevent derailment; the auxiliary rail contact assembly pair has a free left and right movement relative to the vehicle main steel wheel, which is greater than the elastic movement of the horizontal guide wheel, so that when the main steel wheel is a conical tread, it does not affect the matching guidance between the conical surface of the main steel wheel and the upper surface of the main steel rail, or when the main steel wheel is a cylindrical tread, it does not affect the matching guidance between the horizontal guide wheel and the inner side of the main steel rail; in addition, the overall free left and right movement of the auxiliary rail contact assembly pair has a limited value, so as to enhance the derailment prevention performance; the overall left-right movement mechanism is: 1) The auxiliary rail contact assembly pair is installed as a whole on a guide rail that can slide freely left and right; 2) The auxiliary rail contact assembly pair is installed as a whole on a rotating shaft or round hole that can rotate freely left and right; 3) The auxiliary rail contact assembly pair is driven by the same air pressure pipeline, the same hydraulic pipeline or the piston of the motor, or magnetic attraction, to squeeze the auxiliary rail from the left and right; the air pressure pipeline, hydraulic pipeline or motor, or magnetic attraction, only controls the squeezing force or release of the auxiliary rail contact assembly pair, and at the same time allows the auxiliary rail contact assembly pair to move freely in the left and right directions as a whole.

[0019] The said vehicle is equipped with a horizontal driving wheel or brake pad, which squeezes the main rail on the outside, inside, or both sides of the main rail or cooperates with the horizontal guide wheel to squeeze the main rail to achieve driving or braking; the horizontal driving wheel or brake pad is raised in the turnout section, diamond intersection section, crossing section, and temperature expansion regulator section to avoid collision with the main rail or other objects.

[0020] The said front of the turnout section, diamond intersection section, crossing section, and temperature expansion regulator section, a rising safety block is installed on the track; when the vehicle is running, the collision safety mechanism of the horizontal driving wheel or brake pad collides with the rising safety block, causing the horizontal driving wheel or brake pad to automatically release the main rail and rise, and then keep in the raised position to continue driving so as not to hit the main rail or other objects; after the vehicle passes the turnout section, diamond intersection section, crossing section, and temperature expansion regulator section, the horizontal driving wheel or brake pad on the vehicle collides with the descending safety block installed on the track again, or triggers optical, electrical, magnetic and other sensors, automatically or manually descends to the outside or inside of the main rail to guide, prevent derailment, or squeeze the main rail for driving or braking.

[0021] The said rail vehicle is equipped with a remote operating controller, which operates and controls the turnout switch machine or diamond cross auxiliary rail rotating machinery through wired or wireless communication to perform track change guidance or traffic guidance.

[0022] The said seats inside the rail vehicle are equipped with seat belts to fix passengers and prevent them from being thrown away during large acceleration or deceleration, causing danger.

[0023] The said main steel wheels with cylindrical treads are independent rolling wheels, and the steering mechanism of the main steel wheel pairs, or the independent steering mechanism of each main steel wheel, are installed on the bogie, or directly installed on the car body when there is no bogie; When on a curve, the front and rear wheel pairs or front and rear wheels have the same steering angle and opposite directions; The front and rear bogies of the car body have the same steering angle and opposite directions; The value of the steering angle matches the turning radius of the track.

BRIEF DESCRIPTION OF THE DRAWINGS

[0024]

FIG. 1 is a cross-sectional view of a railway vehicle body and a steel rail and steel wheel structure of the present invention.

FIG. 2 is an oblique view of the steel rail and steel wheel structure of FIG. 1.

FIG. 3 is an oblique view of a scene in which the horizontal auxiliary wheel 8 of FIG2 is replaced with an auxiliary brake pad.

FIG. 4 is a cross-sectional view of FIG. 3.

FIG. 5 is an enlarged oblique view, in which a buffer wheel 23 is added before and after the auxiliary brake pad of FIG. 4.

FIG. 6 replaces the left-right movement of the brake caliper 20 of FIG. 4 with left-right rotation. The main steel wheel tread is a cylindrical surface.

FIG. 7 is a track-changing turnout of the present invention, which is suitable for the above-mentioned rail and steel wheel structure with auxiliary rails and main steel wheel flanges.

FIG. 8 replaces the main steel wheel with a flange and a conical tread of FIG. 1 with a main steel wheel without a flange and a cylindrical tread.

FIG. 9 is a turnout of the present invention that changes tracks by swinging the auxiliary rail left and right, and goes straight.

FIG. 10 is the turnout of FIG. 9, in the state of turning and changing tracks.

FIG. 11 is a combination of FIG. 9 and FIG. 10, with the swinging auxiliary rail indicated by a dotted line.

FIG. 12 is an elevation view of the auxiliary rail track change section passing over the main rail 36 from above at 41 and 46.

FIG. 13 is a plan view of the auxiliary rail track change section passing over the main rail curved portion from above at 41.

FIG. 14 is a plan view of the auxiliary rail track change section curved portion 45 passing over the main rail straight portion from above at 46.

FIG. 15 is a plan view of a turnout of the present invention that changes tracks by swinging the track change guide rail to the left and right.

FIG. 16 is a cross-sectional view of FIG. 15.

FIG. 17 is a turnout of the present invention that changes tracks by swinging the auxiliary rail to the left and right and cooperating with the fixed outer track change auxiliary rail.

FIG. 18 is a turnout of the present invention that changes tracks by swinging two auxiliary rails left and right.

FIG. 19 is a turnout of the present invention that changes tracks by swinging auxiliary rails left and right and cooperating with outer guide rails and inner guide rails.

FIG. 20 is a cross-sectional view of the outer guide rail and inner guide rail of a single wheel in FIG. 19.

FIG. 21 is a main rail 36 combined with an outer guide rail and an inner guide rail to form a rail 76 with a rail flange.

FIG. 22 is a turnout of the present invention that changes tracks by swinging the auxiliary rail left and right and cooperating with the outer guide rails of two wheels.

FIG. 23 is a cross-sectional view of the auxiliary rail of FIG. 8 of the present invention, by adding a linear motor stator.

FIG. 24 is an oblique view of FIG. 23.

FIG. 25 is a wheel-rail structure of a flanged cylindrical tread main steel wheel 27 and a linear motor auxiliary rail 80.

FIG. 26 is a diamond intersection when a flangeless cylindrical tread main steel wheel 37 and a rotationally switchable auxiliary rail are used.

FIG. 27 is a diamond intersection when a flangeless cylindrical tread main steel wheel 37 and a flanged main rail are used.

FIG. 28 is a crossing where the track and the road have a plane intersection when using the flangeless cylindrical tread main steel wheel 37.

FIG. 29 is a cross-sectional view of the scene of the flangeless main steel wheel rolling and guiding on the main rail.

FIG. 30 is an oblique view of FIG. 29.

FIG. 31 shows that a railway vehicle horizontal guide wheel pair 86 rotates as a whole with the steering wheel pair at a rail curve.

FIG. 32 shows that a railway vehicle horizontal guide wheel pair 86 rotates as a whole with the individual steering wheel at a rail curve.

FIG. 33 shows that a railway vehicle horizontal auxiliary wheel pair 8 rotates as a whole with the steering wheel pair at a rail curve.

FIG. 34 shows that a railway vehicle horizontal auxiliary wheel pair 8 moves in parallel with the individual steering wheel at a rail curve.

FIG. 35 shows that a railway vehicle body is mounted on two bogies at a rail curve to make a turn.

FIG. 36 shows a central auxiliary rail laid in the track, and a derailment prevention member horizontal claw 100 mounted on the bogie, wherein the horizontal claw embraces the upper wing of the I-shaped auxiliary rail to prevent the vehicle from moving upward, left, or right.

FIG. 37 shows that in the railway turnout section, the auxiliary rail 7 is not laid, and the horizontal claw 100 can pass smoothly, but there is no derailment prevention function.

FIG. 38 shows that two auxiliary rails are laid on the outside of the main rails, and two derailment prevention claws respectively cooperate with them to embrace the two auxiliary rails to achieve strong derailment prevention, and the auxiliary rail can also be used as a power supply rail.

FIG. 39 shows that two auxiliary rails are laid on the outside of the main rails, and the two derailment prevention claws are respectively embraced by the two auxiliary rails to achieve strong derailment prevention.

FIG. 40 shows a turnout of the present invention, wherein the rails do not swing, and the railway vehicle performs a steering operation and passes through the turnout track change guide rail to achieve track change.

FIG. 41 is a cross-sectional view of FIG. 40, wherein the track change guide wheels 114 and 115 move up and down, and cooperate with the track change guide rails 112 and 113 to guide the track change.

FIG. 42 shows a turnout similar to that of FIG. 40, but outside the turnout, the auxiliary rail is changed from one to two 116, which are respectively on the outside of the main rail.

FIG. 43 is a cross-sectional view of the turnout, similar to FIG. 41, wherein the track change guide rails 117 and 118 are fixed on the sleepers.

FIG. 44 is a cross-sectional view of the turnout, wherein the left and right guide wheels 121 and 122 are not switched up and down, but switched horizontally.

FIG. 45 is another turnout of the present invention in which the track is not switched by swinging and the railway vehicle performs a steering operation and passes the rail flange to achieve track change.

FIG. 46 is a cross-sectional view of FIG. 45, wherein the track change guide wheels 125 and 126 move left and right, and cooperate with the track change guide walls 123 and 124 to guide the track change.

FIG. 47 is an enlarged view of the divergence point 39 of FIG. 45.

DETAILED DESCRIPTION

[0025] The current railway motion mechanism of steel rail track and steel wheel vehicle was established on the basis of the design and manufacture of William Jessop, a British civil engineer. In 1789, Jessop first designed convex rails and cast iron wheels with protruding outer rims, and applied them to the horse-drawn railway of Loughborough-Leicester. Later, he developed cast iron wheels and railway turnouts with protruding inner rims, which became the standard form of modern railway wheels and rails. In 1825, British engineer George Ste-

phenson invented and manufactured the world's first truly practical passenger and freight steam locomotive Locomotion No.1, which adopted this motion mechanism of steel rail track and steel wheel vehicle. Later, locomotives developed into fuel locomotives and electric locomotives, but this rail structure has remained unchanged. Later, many other methods of rail transportation appeared, such as concrete track rubber tire trains, monorail trains, suspension trains, vacuum tube trains, maglev trains, roller coasters in amusement parks, rocket sled railway, etc. However, the above-mentioned motion mechanism of steel rail track and steel wheel vehicle has become the most widely used rail transportation method in countries around the world due to its comprehensive performance, and is widely used in passenger and freight ordinary railways, passenger subways, passenger high-speed railways, etc. Therefore, the railway trains with the above-mentioned steel rail track and steel wheel vehicle are called wheel-rail railways or wheel-rail trains.

[0026] Among them, the Shanghai Maglev Train, the roller coaster in the amusement park, and the rocket skid train all adopt the structure of the vehicle hugging the track, that is, the track hugging structure, which can make the train impossible to derail without the track and the train being damaged in advance. Therefore, they are called non-derailed trains. The definition of non-derailment is that it is impossible to derail without the track or vehicle being damaged in advance, which is the performance of the vehicle's motion stability. Most of the derailment accidents that have occurred so far are caused by earthquakes, typhoons, high speeds, turns, emergency braking, etc., and the track or vehicle is not damaged in advance. Non-derailment is not absolute non-derailment. When the track or vehicle has been damaged in advance, for example, the track is covered by mudslides, bridge collapses, etc., resulting in the track being damaged in advance, or collisions cause the vehicle to be damaged in advance, derailment will still occur. However, this is a complex situation and cannot be classified as motion stability.

[0027] For wheel-rail railways, the track gauges of steel rail and steel wheel railways vary from country to country. The narrow ones are 610 mm, 822 mm, and 891 mm. The medium ones are 1000 mm, 1073 mm, 1378 mm, and 1435 mm. The wide ones even reach 1524 mm, 1886 mm, and 2141 mm. In 1937, the International Railway Association stipulated that the track gauge of 1435 mm is the international standard track gauge, the track gauge above 1520 mm is the wide track, and the track gauge below 1073 mm is the narrow track. Compared with rubber tire buses or cargo trucks, steel rail and steel wheel railway trains save energy and have a fast operating speed of up to 350 km/h. However, they are generally unable to accelerate or decelerate suddenly, go uphill or downhill suddenly, or make sharp turns, which is greatly restricted. After more than a hundred years of technological research and development, people have not yet achieved the above performance indicators on wheel-rail trains in any railway line, although the above performance indicators are the dream of technicians from all over the world. Because it is difficult to achieve all the above performances in the same railway line, people have developed some trains to achieve some of the above performances and sacrifice other performances. For example, concrete track rubber tire trains have the performance of rapid acceleration and deceleration, rapid uphill and downhill, and sharp turns, but do not have the performance of high speed 350km/h and energy saving. The magnetic levitation method has the performance of more than 430km/h, but does not have the excellent low-speed energy saving performance, and it is difficult to adapt to large load changes. There are also great problems in construction cost, operation cost, safety, etc.

[0028] People have not been discouraged and have been trying various different technologies. Among them, the method of using auxiliary rails has attracted the attention of many people. More than 100 years ago, people developed the rack railway for mountain climbing. The rack railway places a special rack on the sleeper between two ordinary steel rails. The locomotive of the rack railway is equipped with one or more gears, which mesh with the rack to run, so that the locomotive can overcome the problem of insufficient adhesion. The Pilatusbahn railway in Switzerland pulls the train up a steep slope with a gradient of up to 48 degrees. There are two main modes of gear systems: Riggenbach rack, where the locomotive's gears mesh with the rack above the rack; Locher rack, where the locomotive meshes with the rack on both sides at the same time. Railways with rack auxiliary rails can be used for mountain climbing, but on the vast plains, the train speed is very slow, consumes a lot of energy, and the advantages are not obvious, so the rack railway is not popular. In 1990, Osaka Metro in Japan built the Nagahori Tsurumi Green Ground Line, which was driven by a linear motor in the steel rail and steel wheel mode. A third track was laid in the middle of the two steel rails as the induction plate of the linear motor. The left and right steel wheels of the vehicle rolled on the two rails to support the weight of the vehicle. The linear motor in the middle and lower part of the vehicle interacted with the induction plate of the third track to drive the vehicle. Compared with wheel-rail drive, it has large acceleration and deceleration and strong uphill and downhill capabilities. However, compared with wheel-rail drive, linear motor drive has lower energy efficiency and no significant improvement in derailment prevention performance. The current maximum operating speed is below 120km/h, and the maximum test speed is 200km/h, which is much lower than the maximum operating speed of 350km/h of wheel-rail drive. Therefore, the application of linear motor drive in the steel rail and steel wheel mode is greatly limited.

[0029] People continue to develop new technologies using auxiliary rails. In Chinese utility model patent CN2871610Y, the locomotive uses two horizontal aux-

iliary wheels to squeeze the waist plate of the auxiliary rail on both sides at the same time, thereby generating friction that is conducive to starting and accelerating, and brakes, starts, and accelerates. In Chinese patent CN102190005B, CN201924244U and WO2011109928A1, the rubber tire of the locomotive presses on the upper surface of the auxiliary rail for driving, and the other two rubber tires squeeze the auxiliary rail on both sides for braking, and the two guide wheels guide on both sides of the auxiliary rail at the same time. In patent CN107380008A, the track has a central auxiliary rail, and the auxiliary rail has left and right magnetic upper wings. The vehicle is equipped with another pair of magnets, which act on the upper wing magnets from below the upper wing to generate supporting force and guiding force. In Japanese patent JP4405904B2, the brake pad presses the upper surface of the central auxiliary rail from top to bottom, or the brake hook rotates 90 degrees to descend and hold the I-shaped upper wing of the central auxiliary rail to brake, prevent derailment and rollover. However, the above-mentioned method of using auxiliary rails to guide, drive, and brake the rail and steel wheel train also creates new problems. For example, the tread of the existing steel wheel is a conical surface, and the left and right steel wheels and the wheel axle form a rigid wheel set. The conical surface here is a generalized conical surface, which has the characteristics of a larger diameter on the inside and a smaller diameter on the outside in the wheel width direction. It can be a simple straight line or a complex curve like the wheels actually used now. There is an automatic steering guidance function between the conical surface of the rigid wheel set and the rail. If the guidance of the auxiliary rail is introduced, the two guidance will interfere with each other. If the guidance of the auxiliary rail is stronger than the guidance of the existing rail, it will cause the steel wheel to slip on the rail or the guiding to fail. The driving or braking of the auxiliary rail will also interfere with the guidance between the conical surface of the rigid wheel set and the rail, and will also cause the steel wheel to slip on the rail or the guiding to fail. The slipping of the steel wheel on the rail or the guide failing is very dangerous, and it should be avoided as much as possible in the existing steel wheel and rail method. Therefore, the introduction of the guidance, driving or braking of the auxiliary rail makes the technical problems complicated, the movement performance of the entire train is affected, the wear of the vehicle increases, and the danger increases, especially in curves and high speeds. In addition, although the auxiliary wheels and auxiliary rails increase the driving force or braking force, they also increase the friction resistance, and the energy consumption may increase. In addition, the existence of auxiliary wheels and auxiliary rails may also make it difficult for trains to change tracks. These problems have not been well solved, so this method is difficult to enter widespread practical use.

[0030] Rail transit using auxiliary rails, in addition to the rack rails and linear motor auxiliary rails as drive rails, also uses auxiliary rails to prevent derailment or deviation. Japan has done a lot in this regard in the past 10 years. For example, Japanese patent JP4723282B2 uses two auxiliary rails as derailment prevention guardrails to prevent derailment, but this method only prevents the train from derailing on the left and right, and cannot prevent the train from derailing upward, so it is a partial prevention of derailment, not a complete prevention of derailment. The prevention of train deviation is to prevent the train from derailing after derailment, but not to prevent the train from derailing. Patent CN106480789A invented a rail with rail flange and wheel guide as well as seamless turnout. The disadvantage is that due to the contact guide between the rail flange and the wheel, there is a lot of wear and noise between them. In patent JP2008024126A, an auxiliary rail with an upper wing is laid on the outside of the two rails, and the vehicle is equipped with a derailment prevention claw that extends under the upper wing of the auxiliary rail to prevent the vehicle from derailing upward when it is lifted. In patents CN113029613A and CN202200989U, a central auxiliary rail is laid between the two rails, with left and right upper wings of I-beams, and the vehicle is equipped with left and right derailment prevention claws that extend under the left and right upper wings of the auxiliary rail, hugging the auxiliary rail to prevent the vehicle from derailing left or right or upward, or preventing getting of track. In the above three anti-derailment structures, auxiliary rails need to be laid, which requires a high cost. All of them only have the function of preventing derailment, so the function-to-cost ratio is not high.

[0031] On the basis of the existing wheel-rail railway train, the present invention adds a vehicle hugging track structure to prevent derailment, which can prevent the train from derailing and completely prevent derailment. Further structural improvements have been made, which can enable the wheel-rail train to obtain the performance of rapid acceleration, rapid deceleration, rapid uphill, rapid downhill, and sharp turns, which is even better than road cars, thereby greatly increasing the competitiveness of the wheel-rail train. In addition, the present invention changes the tread shape of the steel wheels of the existing ordinary railway and high-speed railway trains from a conical surface to a cylindrical surface, from a rigid wheel set to a differential wheel set, and adds a horizontal guide wheel. The horizontal guide wheel rolls on the vertical surface of the auxiliary rail or the main rail for strong guidance to prevent derailment. This structure eliminates the hunting oscillation of the railway vehicle running, makes the railway vehicle run more smoothly, with less lateral vibration, the high-speed railway is faster, the high-speed railway track can be used for heavy freight, and the high-speed railway vehicle can make a smaller radius turn. Reference will now be made in detail to some embodiments, examples of which are illustrated in the accompanying drawings. The following description refers to the accompanying drawings in which the same

numbers in different drawings represent the same or similar elements unless otherwise represented. The implementations set forth in the following description of some embodiments do not represent all implementations consistent with the present disclosure. Instead, they are merely examples of apparatuses and methods consistent with aspects related to the disclosure as recited in the appended claims.

[0032] FIG. 1 is a cross-sectional view of a railcar body and a rail and steel wheel structure of this invention. FIG. 2 is an oblique view of the rail and steel wheel structure of FIG. 1. 1 is the main rail, which has an I-shaped cross section and can be a traditional rail. 2 is a sleeper. 3 is the main steel wheel, which can be a driving wheel, a brake wheel, or a driven wheel, or a traditional steel wheel. 4 is the tread of the main steel wheel, which rolls on the upper surface of the main rail. The diameter of the tread along the thickness of the steel wheel is different, forming a nearly conical tread. Usually, the conicity of the tread is about 1/20 for ordinary railways and about 1/40 for high-speed railways. 5 is the flange of the steel wheel, which is on the inner side of the left and right steel wheels and is used for train track change and train derailment prevention. 6 is the axle. The left and right steel wheels 3 and the axle 6 are rigidly fixed together to form a rigid wheelset. When the rigid wheelset rolls, the rolling angular velocity of the left and right steel wheels 3 is the same. The distance between the inner side of the upper wing of the I-shaped left and right rails 1 is called the track gauge, which is represented as A here. When the track gauge is equal to 1435mm, it is called the standard track gauge, greater than 1435mm is called the wide track gauge, and less than 1435mm is called the narrow track gauge. The distance between the outer side of the wheel flange 5 of the left and right steel wheels 3 is called the wheel flange distance, which is represented as B here. The wheel flange distance B is smaller than the track gauge A so as not to get stuck and to facilitate the wheelset to roll on the two curved rails. The difference C = A - B is called flange gap. When the track gauge is standard, the flange gap C is about +/-3mm at the straight rail and greater at the curved rail. When the train wheelset rolls, the wheelset swings left and right between the two rails. The conical tread of the wheelset produces the function of the rigid wheelset center automatically returning to the center line of the rail. This is the hunting oscillation of the train. There is no problem with hunting oscillation when the train is running at a low speed, but when it is running at a high speed, the frequency of hunting oscillation is fast, the acceleration of the left and right swing is large, and it is easy to lose the running stability and then derail. Therefore, there is an upper limit value set as the maximum speed of the train to run safely. 1 to 6 are traditional train rails and steel wheels. Compared with rubber tires and concrete pavement of cars, the rolling friction coefficient of the rails and steel wheels of trains is small, and the energy consumption of rolling operation is small. However, because the rolling friction coefficient of the rails and steel wheels of trains is small, the acceleration of the train is small when it departs, and the braking distance of the train is long when it slows down, making the train inflexible and causing traffic accidents easily. When the rigid main steel wheel pair turns, the rolling relationship between the conical tread of the main steel wheel and the upper surface of the main steel rail is complex, and it is easy to slide. Therefore, the turning radius of the train and the track curve radius are large, and it is not suitable for small radius turns.

[0033] In order to solve the problem of the adverse effects of a small rolling friction coefficient, the present invention adds an auxiliary rail and a horizontal auxiliary wheel pair on the basis of the traditional rail and steel wheel structure. 7 is the auxiliary rail of the present invention, which is laid in the center of the two traditional rails 1 and has an I-shaped cross section. The I-shaped upper wing position of the auxiliary rail 7 is higher than the upper surface of the main rail 1. 8 is the horizontal auxiliary wheel of the present invention, which is horizontally arranged, forming a pair on the left and right, and rolling on the left and right sides of the waist of the auxiliary rail 7. The horizontal auxiliary wheel 8 is higher than the upper surface of the traditional rail 1. Since the upward movement of the horizontal auxiliary wheel is hindered by the upper wing, the vehicle is not lifted and not overturned. The typical material of the auxiliary rail 7 is ferroalloy material, but it is not limited to ferroalloy material. The left and right sides of its waist are rolling friction surfaces, that is, auxiliary rail treads, which are not sawtooth-shaped, and the material is a wear-resistant material such as metal alloys and ceramics. The rolling tread of the horizontal auxiliary wheel 8 is a cylindrical surface, not a gear, and the material is a wear-resistant material such as metal alloys and ceramics, not rubber. The rolling friction surface is suitable for the high-speed rotation of the horizontal auxiliary wheel 8. 9 is a horizontal driving piston, which makes the wheel pair of the horizontal auxiliary wheel 8 squeeze the auxiliary rail 7 from the left and right, and the squeezing force is adjustable and can be loosened. 10 is a fixed clamp of the horizontal auxiliary wheel 8 mechanism assembly, which does not move left and right relative to the main steel wheel 3 and supports the horizontal driving piston 9. 11 is a driving wheel of the horizontal auxiliary wheel 8, such as a motor, or a wheel connected to the motor. 12 is a brake wheel of the horizontal auxiliary wheel 8, such as a disc brake wheel, or a wheel connected to a disc brake wheel. The driving wheel 11 and the brake wheel 12 are connected to the horizontal auxiliary wheel 8, so that the horizontal auxiliary wheel 8 can be switched to an auxiliary driving wheel, an auxiliary brake wheel or an auxiliary driven wheel at different times. The driving wheel 11 and the brake wheel 12 can be the same wheel. Relative to the auxiliary rail 7 and the horizontal auxiliary wheel 8, the traditional steel rail and steel wheel are here called the main steel rail and main steel wheel. The main steel rail and the main steel wheel are load-bearing steel rails

and steel wheels, and the auxiliary rails and the horizontal auxiliary wheels are non-load-bearing rails and wheels. 13 is the body of the train. 14 is the joint of the main steel rail 1 in the length direction, including straight seams, oblique seams, and welded seams. The impact force of the steel wheel 3 when rolling over the oblique seams and welded seams is small, and the impact force when rolling over the straight seams is large. The temperature stress of the straight seams and oblique seams is small, and the temperature stress of the welded seams is large. The welded seams are metal materials welded together, and there is actually no gap. 15 is the joint of the auxiliary rail 7 in the length direction, including straight seams, oblique seams, serrated seams, welded seams, etc. The tread width of the horizontal auxiliary wheel 8 can be wider, for example, greater than 100mm, so that when the horizontal auxiliary wheel 8 rolls over the oblique seams or serrated seams of the auxiliary rails, without producing a large impact. 3 to 12 are installed on the bogie under the body. Usually, a train body is installed on two bogies to facilitate turning. When the body is short, because it is easy to turn, one bogie is sufficient, and it can be merged with the body into one, and then the body also becomes a bogie. Usually, a bogie has 4 main steel wheels. The two main steel wheels on the left and right form a wheelset.

[0034] The main rail 1, the auxiliary rail 7 and the sleeper 2 are the track parts, which are fixed together by fasteners. The width of the sleeper in the length direction of the track is short, and the bottom of the sleeper and between the adjacent sleepers are filled with gravel, which becomes a ballasted track. The cost of the ballasted track is low, but the track settlement is large. Or, the width of the sleeper in the length direction of the track is long, and the adjacent sleepers are close to each other, without gravel, and become a ballastless track. The cost of the ballastless track is high, but the track settlement is small. 3 to 13 are the vehicle parts. 3 to 12 can be directly installed on the lower frame of the car body, or can be installed on the bogie first, and the lower frame of the car body is then installed on the bogie. The main steel wheel 3 rolls on the main rail 1 to support the total weight of the vehicle part. The main steel wheel 3 also provides driving, braking or guiding of the vehicle. The horizontal auxiliary wheel 8 cooperates with the auxiliary rail 7, does not support the weight of the vehicle, and only provides driving, braking or preventing derailment of the vehicle. The squeezing force between the horizontal auxiliary wheel 8 and the auxiliary rail 7 is controlled by the squeezing mechanism, and The squeezing power is adjustable and can be loosened. The rolling of the traditional steel wheel 3 on the steel rail 1 can provide driving, braking and guiding, but the performance is too weak and has many disadvantages. The present invention adds the auxiliary rail 7 and the horizontal auxiliary wheel 8, and through their cooperation, the driving, braking and derailment prevention performance of the vehicle can be greatly improved.

[0035] Although the addition of auxiliary rails 7 and horizontal auxiliary wheels 8 can greatly improve the driving, braking and derailment prevention performance of the vehicle, the main rails 1 and steel wheels 3 already have driving, braking and guiding functions, and there may be interference between them. If the mutual interference is not handled well, it may be completely unfeasible or the advantages are not worth it. Therefore, the present invention performs the following processing: when the horizontal auxiliary wheel pair 8 rolls and squeezes the auxiliary rails 7 from the left and right vertical surfaces, the horizontal auxiliary wheel pair 8 has an overall left and right free movement relative to the main steel wheels of the vehicle, and its maximum movement is within the range that the main steel wheel does not derail from the main steel rail, which is about half the tread width of the main steel rail 1 plus half the tread width of the main steel wheel 3. For safety reasons, it can be simply said to be within half the tread width or full width of the main steel rail 1. For standard gauge, there are several types of commonly used steel rails, and the full width of the main steel rail 1 is about 75mm. Due to this treatment, the cooperation between the horizontal auxiliary wheel 8 and the auxiliary rail 7 does not affect the normal hunting oscillation of the main steel wheel 3 on the main steel rail 1. However, when the left and right movement of the main steel wheel 3 is too large and may cause derailment, the guidance of the horizontal auxiliary wheel 8 and the auxiliary rail 7 limits the left and right movement of the main steel wheel 3 to further increase, making it not to derail. Moreover, the I-shaped upper wing of the auxiliary rail 7 prevents the upward movement of the horizontal auxiliary wheel 8 located below. Therefore, if the auxiliary rail 7 and the horizontal auxiliary wheel 8 are not damaged, the vehicle cannot derail upwards or roll over.

[0036] In FIG. 1 and FIG. 2, the two horizontal auxiliary wheels 8 on the left and right of the auxiliary rail 7 are driven by the two horizontal driving pistons 9 on the left and right, so that the horizontal auxiliary wheels 8 squeeze the auxiliary rail 7 from the left and right. The fixed clamp 10 is a component that does not move relative to the main steel wheel 3 left and right, and supports the horizontal driving piston 9. The horizontal driving piston 9 can be a hydraulic piston or a pneumatic piston. When the left and right pistons are controlled by the same hydraulic or pneumatic driving source, the pressure of the left and right horizontal auxiliary wheels 8 on the auxiliary rail 7 can be equal, but the overall left and right movement of the left and right horizontal auxiliary wheels 8 is not limited, so that the left and right movement of +/-75mm can be achieved. The horizontal driving piston 9 can also be driven by the piston of the motor, or by magnetic attraction, to achieve squeezing and overall left and right movement.

[0037] The maximum driving force or braking force of the main steel wheel is proportional to the friction coefficient and pressure between the main steel wheel 3 and the main steel rail 1. The energy consumption of train movement also increases with the increase of friction

coefficient and pressure. The friction coefficient is mainly related to the steel wheel and rail material. The friction coefficient of the steel wheel and rail material is smaller than that of the automobile rubber tire on concrete road surface, so the train movement energy consumption is small. The pressure between the steel wheel and the rail increases with the increase of the vehicle's own weight and load. Light pressure makes the train movement energy consumption small. Increasing the maximum driving force or braking force by increasing the vehicle weight cannot effectively improve the sudden acceleration or sudden braking performance, but makes the acceleration or braking performance worse. However, for the horizontal auxiliary wheel 8 and the auxiliary rail 7, although the friction coefficient is approximately the same as the friction coefficient between the main steel wheel 3 and the main rail 1, the pressure between them can be achieved by hydraulic pressure, air pressure, electromagnetic pressure, etc., and the pressure can be adjusted to increase to much greater than the pressure of the main steel wheel on the main rail, and the squeezing drive mechanism does not largely increase the total weight of the vehicle. Therefore, the cooperation of the horizontal auxiliary wheel 8 and the auxiliary rail 7 can obtain a greater driving force or braking force, thereby effectively improving the vehicle's performance of sudden acceleration, sudden braking, and climbing steep slopes.

[0038] In FIG. 1 and FIG. 2, the rolling of the traditional steel wheel 3 on the rail 1 can provide certain driving, braking and guiding performance. The actual operating speed is 350km/h, which is a good indicator that cannot be ignored. If it is completely replaced with another method, the details may not be considered very carefully in a short time, and the operating speed of 350km/h may not be achieved. The present invention increases the cooperation of the horizontal auxiliary wheel 8 and the auxiliary rail 7, the purpose is to increase the driving force or braking force, but also increases the friction resistance of the horizontal auxiliary wheel 8 and the auxiliary rail 7. In order to reduce energy consumption, the following control can be performed: the driving force or braking force of the main steel wheel 3 has a set value. When the driving force or braking force of the main steel wheel 3 is less than the set value, only the driving or braking of the main steel wheel 3 is used, and the driving and braking of the horizontal auxiliary wheel 8 are not used. The squeezing pressure of the horizontal auxiliary wheel 8 is adjusted to below a certain set value, or even loosened. When the driving force or braking force of the main steel wheel 3 is equal to or greater than the set value, the main steel wheel 3 may slip. At this time, the driving or braking of the main steel wheel 3 and the driving or braking of the horizontal auxiliary wheel 8 are used simultaneously. The driving force or braking force of the horizontal auxiliary wheel 8 is related to the driving or braking motive force and is also related to the squeezing force of the horizontal auxiliary wheel 8. A relationship in which the squeezing force increases with the increase of the motive force can be set in advance to avoid excessive squeezing force when the motive force is small, resulting in large friction resistance. It is also avoided that the squeezing force is too small when the motive force is large, causing the horizontal auxiliary wheel 8 to slip when rolling on the surface of the auxiliary rail 7.

[0039] FIG. 3 is a scene in which the horizontal auxiliary wheel 8 of FIG. 2 is replaced with an auxiliary rail brake pad, an oblique view. FIG. 4 is a cross-sectional view of FIG. 3. 17 is an auxiliary rail with a serrated end face. 18 is an auxiliary rail brake pad. The brake pad is composed of a steel plate, an adhesive heat insulation layer and a friction block, wherein the heat insulation layer is composed of a non-heat-conducting material for the purpose of heat insulation; the friction block is composed of a friction material and an adhesive, and is squeezed on the auxiliary rail tread to generate friction during braking, thereby achieving the purpose of vehicle deceleration and braking. From the composition of the friction material, the brake pad is mainly divided into the following categories: asbestos brake pad, semi-metal brake pad, low-metal brake pad, NAO formula brake pad, ceramic brake pad, NAO ceramic brake pad. 19 is a horizontal driving piston of the auxiliary rail brake pad 18. 20 is a brake caliper of the auxiliary rail brake pad. 21 is a left and right moving guide rail of the brake caliper 20. 22 is an integral component fixing part, which does not move left and right relative to the main steel wheel 3 and supports the brake caliper 20. The auxiliary rail brake pad 18 is driven by a horizontal driving piston 19 of hydraulic, pneumatic, electromagnetic or mechanical pliers. When the auxiliary rail 17 is squeezed from the left and right sides, the brake caliper 20 can move left and right relative to the fixing part 22 by moving the guide rail 21 left and right to achieve sufficient left and right movement. 15 in FIG. 3 is the zigzag end face joint of the auxiliary rail.

[0040] The auxiliary rail brake pad 18 in FIG. 3 and 4 is squeezed by hydraulic pressure, air pressure, electromagnetic pressure or mechanical clamp pressure, and can also be squeezed by magnet attraction, that is, using a magnetic rail braking method. The current magnetic rail braking can obtain a greater braking force than the main steel wheel 3. Although the direct friction between the magnet wear plate and the auxiliary rail tread will generate a lot of heat and cause damage to the auxiliary rail, the auxiliary rail is not a load-bearing rail, the auxiliary rail tread is wider, and even if the auxiliary rail j oint is an oblique seam or a serrated seam, there is no great impact, so the auxiliary rail is relatively easy to repair and replace. The auxiliary rail tread can be made of highly wear-resistant materials such as alloys or ceramic materials to increase its service life.

[0041] Regarding the connection structure of the oblique seam or serrated seam of the auxiliary rail, a rail joint clamp, also called a fishtail plate, is used to clamp the lower part of the I-shaped tread at the auxiliary rail j oint from left and right, or the upper wing, and then bolts are

passed through the long holes of the rail joint clamp or the auxiliary rail to fix the auxiliary rail. The rail joint clamp limits the left and right movement of the end faces of the two auxiliary rails, but the long holes do not limit the movement of the end faces of the two auxiliary rails in the length direction, so that when there is a temperature change, the two auxiliary rail end faces are allowed to expand and contract along the length direction. This connection structure is widely used at the joints of traditional straight seams of steel rails, but the tread width of traditional steel rails is small and it is difficult to make oblique seams or serrated seams. The tread of the auxiliary rail is relatively wide, which is suitable for making oblique seams or serrated seams. This connection structure can also be used for straight seams of auxiliary rails, but the impact during straight seams is relatively large and should be avoided as much as possible.

[0042] In addition, the linear eddy current brake of the non-friction braking method can also act on the auxiliary rail to generate a strong braking force. For example, a linear eddy current brake assembly is installed on the vehicle, located above the auxiliary rail, and acts on the upper wing of the auxiliary rail for non-friction braking, or the left and right linear eddy current brake assemblies that are higher than the main rail tread form a pair, acting on the auxiliary rail tread from the left and right to perform non-friction braking. The linear eddy current brake assembly is non-contact and non-friction, and has no mechanical wear.

[0043] FIG. 5 is an enlarged oblique view. Buffer wheels 23 are added before and after the auxiliary rail brake pad in FIG. 4 to reduce the impact generated when the auxiliary rail brake pad passes through the joint 15 of the auxiliary rail 7. The buffer wheel 23 is supported by a spring plate. When the horizontal driving piston 19 drives the squeezing, the buffer wheel 23 first contacts the auxiliary rail tread. When the squeezing is further driven, the auxiliary rail brake pad 18 also contacts the auxiliary rail tread for braking. When the horizontal driving piston 19 drives away, the auxiliary rail brake pad 18 first leaves the auxiliary rail tread. When it is further driven away, the buffer wheel 23 leaves the auxiliary rail tread. 24 is a movable guide rail of the horizontal driving piston 19. The buffer wheel 23 can also play a guiding role.

[0044] FIG. 6 replaces the left and right movement of the brake caliper 20 in FIG. 4 with left and right rotation. 25 is a brake caliper. 26 is a rotation axis of the brake caliper. The rotation axis does not move left and right relative to the main steel wheel 3 and is fixed to the vehicle body. The brake caliper 25 rotates around this axis to enable the auxiliary rail brake pad 18 to achieve sufficient left and right movement. An angular rotation is allowed between the auxiliary rail brake pad 18 and the horizontal driving piston 19 so that when the brake caliper 25 rotates, the auxiliary rail brake pad 18 has a good surface contact with the auxiliary rail tread.

[0045] Because of the guidance of the auxiliary rail 7 or 17, the function of the conical tread of the main steel wheel 3 becomes unnecessary. The conical tread can be replaced with a cylindrical tread. 27 is the main steel wheel. 28 is the cylindrical tread. 29 is the wheel rim. 30 is the wheel axle. In the case of the conical tread, the left and right main steel wheels need to be rigidly fixed on the wheel axle to form a rigid wheel pair. The conical tread can produce a hunting oscillation so that the center of the main steel wheel pair 3 can be reset to the center of the main steel rail at any time. In the case of the cylindrical tread, the guidance of the auxiliary rail 7 or 17 can make the center of the main steel wheel pair always remain at the center of the main steel rail. At this time, the left and right main steel wheels are not rigidly fixed on the wheel axle, but can rotate independently, and their rolling angular velocities can be different, forming an independently rolling main steel wheel pair, so that the left and right main steel wheels can travel different lengths when turning, without sliding, and the train can turn easily. In the cylindrical tread, the horizontal auxiliary wheel 8 or the auxiliary rail brake pad 18 can be fixed left and right, or have a small amount of free movement left and right, for example, within +/-5mm. The cylindrical tread wheel itself does not produce hunting oscillation, and the left and right sway of the vehicle is reduced, which is conducive to increasing the maximum speed of the train, for example, further increasing the maximum operating speed of the train of 350km/h.

[0046] FIG. 7 is a turnout of the present invention, which is suitable for the above-mentioned rail and steel wheel structure with auxiliary rails and main steel wheel flanges, whether it is a conical tread or a cylindrical tread. 31 is the point rail part. 32 is a switch machine, which moves the point rail position so that the vehicle can change tracks. 33 is a guard rail. 34 is a wing rail. 35 is a frog, which has a fixed frog and a movable frog. The fixed frog has no movable mechanism, has a large harmful space, and has a large impact when the main steel wheel rolls over. The movable frog has a movable mechanism, but has a small harmful space, and has a small impact when the main steel wheel rolls over. The turnout of FIG. 7 is basically the same as the traditional turnout, except that an auxiliary rail is added at the entrance and exit of the main steel rail. The auxiliary rail is not laid in the turnout section. When the horizontal auxiliary wheel pair of the train passes through the interrupted section of the auxiliary rail, it is opened without clamping and squeezing, so that after passing through the interrupted section of the auxiliary rail, it can be smoothly re-sleeved on both sides of the auxiliary rail. At this time, the vehicle is guided by the conical tread 4 or the wheel flanges 5 and 29 of the main steel wheel. In the auxiliary rail interruption section of the turnout section, the non-contact linear eddy current brake assembly also stops working. Because the auxiliary rail 7 protects the frog, the guard rail 33 and the wing rail 34 can also be omitted.

[0047] During the movement of the train, the horizontal auxiliary wheel pair is sleeved on both sides of the auxiliary rail tread. When the squeezing starts, the linear

speeds of the horizontal auxiliary wheel tread and the auxiliary rail tread may be inconsistent. For example, during the movement of the train, the horizontal auxiliary wheel may be in a state of rotation stop. At this time, there is a speed difference between the auxiliary wheel tread and the auxiliary rail tread of the train movement. This speed difference causes sliding friction during squeezing, and there is wear between the horizontal auxiliary wheel tread and the auxiliary rail tread. In order to reduce wear, the horizontal auxiliary wheel can be rotated before squeezing, so that the speed of the horizontal auxiliary wheel rotating tread to the ground is equal to zero, and then contact squeezing is performed. At the beginning of contact squeezing, the horizontal auxiliary wheel does not apply driving force and braking force, and is in a driven wheel state to reduce friction. In addition, the elastic squeezing can also easily control the squeezing force to be small. The small squeezing force produces a small sliding friction force, which can make the horizontal auxiliary wheel rotate, and the speed relative to the ground is equal to zero, which becomes rolling friction. After becoming rolling friction, the squeezing force and driving force or braking force of the horizontal auxiliary wheel are adjusted to drive or brake.

[0048] FIG. 8 is a main steel wheel with a flange and a conical tread in FIG. 1 of the present invention replaced with a main steel wheel without a flange and a cylindrical tread. The main rail has also been changed, especially the track switch. 36 is the main rail, and the cross-section is roughly the same as the traditional rail 1, but the rail top tread is a flat surface in order to match the wheel cylindrical tread well, as shown in the FIG. 8. 37 is the main steel wheel without a flange and a cylindrical tread. The left and right main steel wheels and the wheel axle 30 are not rigidly fixed together, but form an independent rolling wheel pair with different rolling angular velocities. 38 is a cylindrical tread.

[0049] The left and right wheel pairs of the horizontal auxiliary wheel 8 can be only driven wheels. The spacing between the two wheels is slightly greater than or equal to the left and right width of the auxiliary rail so as to guide the vehicle and form a horizontal guide wheel pair. The horizontal guide wheel is fixed to the lower part of the vehicle using a spiral spring or a spring plate so that when the train swings left and right during operation, the horizontal guide wheel elastically contacts or elastically collides with the auxiliary rail tread to relieve the impact and improve the left and right stability of the train during operation. At the same time, the elastic movement of the elastic fixation is limited to a certain amount, thereby limiting the left and right movement of the vehicle body and the main steel wheel, so that the main steel wheel does not fall off the main steel rail, and maintains a good derailment prevention effect.

[0050] In FIG. 8, the main steel rail 36 supports the weight, drive, and brake of the vehicle without guiding. The auxiliary rail guides, drives, and brakes. Because it is a cylindrical tread, the width of the tread along the width direction of the main steel rail 36 is large, and the tread compressive stress between the main steel rail 36 and the main steel wheel 37 is small, which is conducive to reducing wear and can extend the operating life of the main steel rail 36 and the main steel wheel 37. The cylindrical tread, in rolling contact with the rail tread on the plane upper surface shown in FIG. 8, has a longer contact length in the width direction than the conical tread of FIG. 4. Therefore, at the rail joint, even if a large-angle oblique or serrated seam is made, the impact of the rail rolling over the joint is small. This is obviously better than the rail 1 with a conical tread steel wheel. The contact surface between the conical tread 4 of the steel wheel and the rail 1 in the traditional standard rail is only about the diameter of a ping-pong ball. When the rail is made into a oblique seam, a long seam length is required to have a small impact effect, and the serrated seam is not effective in reducing the impact. Therefore, the oblique seam of the rail 1 is not easy to make, and the serrated seam is rarely used in practice. Since the oblique seam of the traditional rail 1 is very long and not easy to make, the oblique seam of the traditional rail 1 is also called a rail expansion adjuster. The rail expansion adjuster uses the relative displacement of the pointed rail or the basic rail to adjust the expansion and contraction of the rail end face. It is often used on large-span bridges and bridgeheads to reduce the huge temperature stress caused by the welded connection of the rail end face that affects the strength of the bridge itself. The inclined seam of the cylindrical tread rail 36 can also adopt the structure of the rail expansion and contraction adjuster, and it is easier to make. The friction coefficient of the rail 36 and the steel wheel 37 is basically unchanged when the materials of the traditional rail 1 and the steel wheel 3 remain unchanged, so the maximum driving force and braking force of the steel wheel 37 are basically unchanged when compared with the traditional rail 1 and the steel wheel 3.

[0051] Because the main steel wheel 37 is a cylindrical tread, no guidance is performed. The guidance of the auxiliary rail 7 and the horizontal auxiliary wheel 8 does not need to consider the interference with the guidance of the main steel wheel 37. Therefore, the left and right free movement of the horizontal auxiliary wheel 8 can be 0mm in theory. However, in reality, the laying straightness of the auxiliary rail 7 has a certain tolerance, and this tolerance interferes with the inertial linear motion of the train when the straight section auxiliary rail and the auxiliary wheel cooperate with the guidance. Therefore, in order to absorb the influence of this tolerance, the left and right free movement can be somewhat, for example, within +/-5mm, so as to make the train movement more stable. For the auxiliary rail guide wheel, it can also be fixed on a spring or a spring plate, and there is a left and right elastic movement, for example, +/-5mm. The driving force or braking force generated by the horizontal auxiliary wheel 8 and the auxiliary rail 7 can be much greater than the driving force or braking force of the main steel wheel 37 as the squeezing force of the horizontal aux-

iliary wheel 8 increases. In order to save energy, the driving force or braking force of the main steel wheel 37 and the driving force or braking force of the horizontal auxiliary wheel 8 are distributed as follows: the driving force or braking force of the main steel wheel 37 has a set value. When the driving force or braking force of the main steel wheel 37 is less than the set value, only the driving or braking of the main steel wheel 37 is used, and the driving and braking of the horizontal auxiliary wheel 8 are not used. The squeezing force of the horizontal auxiliary wheel 8 is adjusted to below a certain set value or even released. When the driving force or braking force of the main steel wheel 37 is equal to or greater than the set value, especially when the driving force or braking force of the main steel wheel 37 is insufficient, the driving or braking of the main steel wheel 37 and the driving or braking of the horizontal auxiliary wheel 8 are used at the same time. The driving force or braking force of the horizontal auxiliary wheel 8 is related to the driving or braking motive force, and is also related to the squeezing force of the horizontal auxiliary wheel 8. A relationship that the squeezing force increases with the increase of the motive force can be set in advance to avoid excessive squeezing force when the motive force is small, thereby generating large friction resistance. It is also avoided that the squeezing force is too small when the motive force is large, causing the horizontal auxiliary wheel 8 to slip when rolling on the surface of the auxiliary rail 7.

[0052] The horizontal auxiliary wheel 8 in Fig. 8 can be replaced with an auxiliary rail brake pad 18 or an auxiliary rail brake pad 18 plus a buffer wheel 23 as in Fig. 5 and Fig. 6. The buffer wheel 23 can also be used for guiding. Because the main steel wheel 37 is a cylindrical tread and does not guide, the free movement of the auxiliary rail brake pad 18 or the auxiliary rail brake pad 18 plus the buffer wheel 23 can be theoretically 0mm, but there can also be some, such as within +/-5mm. The braking force of the auxiliary rail brake pad increases with the increase of the squeezing force, and can be much greater than the braking force of the main steel wheel 37. In the disc brake of the automobile, the braking force generated between the brake disc and the brake pad of the metal or ceramic material is generally greater than the braking force between the automobile rubber tire and the road surface. Although the friction coefficient between the metal or ceramic material is generally less than the friction coefficient between the tire and the road surface, the squeezing force between the metal or ceramic material is much greater than the pressure between the tire and the road surface. Thus, the friction braking force between the metal or ceramic material is greater than the friction between the tire and the road surface. In one or more train bodies, one or more of the horizontal auxiliary wheels 8, auxiliary rail brake pads 18, and auxiliary rail brake pads 18 plus buffer wheels 23 can be installed simultaneously to obtain the required braking performance.

[0053] FIG. 9 is a turnout of the present invention that changes tracks by swinging the auxiliary rail left and right, and goes straight. In the turnout section, the main rail has no movable part and has a divergence point and a frog. 39 is the divergence point of the main rail. 40 is the state where the auxiliary rail change section switches to the straight state. 41 is the intersection point where the straight section of the auxiliary rail change section passes over the curved section of the main rail from above. 42 is the straight fixed rail end of the auxiliary rail. 43 is the turning fixed rail end of the auxiliary rail. 44 is the frog of the main rail. In order to facilitate the left and right swinging of the auxiliary rail, the upper wing and the lower wing of the auxiliary rail can be disconnected and discontinuous at intervals. The tread part of the auxiliary rail is thin, and the switch machine can apply force to make it elastically bend. The tread part can also have a serrated hinge structure and bend freely. Because the width of the horizontal guide wheel and the horizontal auxiliary wheel 8 is large, the squeezing stress can be very small, so the impact is not great when rolling over the serrated hinge.

[0054] FIG. 10 is the turnout of FIG. 9, the state of turning and changing tracks. 45 is the state of the auxiliary rail changing track section switching to turning. 46 is the intersection point where the turning part of the auxiliary rail changing track section passes over the straight part of the main rail from above.

[0055] FIG. 11 is a combination of FIG. 9 and FIG. 10, and the auxiliary rail swinging left and right is represented by a dotted line. Since the main steel wheel 37 has no wheel flange, there can be no gap between the divergence point 39 of the main rail and the upper surface of the frog 44, so there is no impact when the main steel wheel 37 rolls over the divergence point 39 and the frog 44. In the entire turnout section, the main rail 36 does not have the weak parts of the traditional rail 1 turnout: the point rail 31 and the frog 35. Therefore, the turnouts of FIG. 9 to FIG. 11 are more solid, require less maintenance, and are more conducive to the high-speed passage of trains.

[0056] FIG. 12 is a vertical view of the situation where the auxiliary rail change section passes over the main rail 36 from above at the intersection 41 or 46. 47 is the lower wing of the I-shaped auxiliary rail change section. 48 is the upper wing of the I-shaped auxiliary rail change section. 49 is the upper extension of the tread of the movable rail end of the auxiliary rail. 50 is the lower extension of the tread of the fixed rail end of the auxiliary rail. 51 is the upper wing of the I-shaped auxiliary rail end of the fixed rail. 52 is the horizontal guide wheel, the horizontal auxiliary wheel 8, the auxiliary rail brake pad 18 or the auxiliary rail brake pad 18 plus the buffer wheel 23. Since the thickness of the upper extension 49 of the tread and the lower extension 50 of the tread are the same, when the horizontal guide wheel, the horizontal auxiliary wheel 8, the auxiliary rail brake pad 18 or the auxiliary rail brake pad 18 plus the buffer wheel 23 with a certain width rolls over or passes through the rectangular zigzag gap

49 and 50, the impact generated is not large. The rectangular serrated seam can also be replaced with a triangular serrated seam or an oblique seam, which has much less impact than a straight seam. In addition, the horizontal guide wheel, the horizontal auxiliary wheel 8, the auxiliary rail brake pad 18 or the auxiliary rail brake pad 18 plus the buffer wheel 23 can be set not to drive or brake in the turnout section, and the auxiliary rail is not squeezed, or the squeezing force is very small, so that the impact can be greatly reduced. For the main steel wheel with a cylindrical tread, the tread is wider, and the joint of the main rail can also adopt a rectangular serrated seam.

[0057] FIG. 13 is a plan view of the auxiliary rail change section straight state 40 passing over the main rail curved portion from above at the intersection 41. 53 is the upper wing extension of the movable rail end 49 of the auxiliary rail 40. 54 is the upper wing extension of the fixed rail end 50 of the auxiliary rail. The upper wing extension 53 of the movable rail end 49 contacts the upper wing extension 54 of the fixed rail end 50, and applies magnetic force or locks, so that the auxiliary wheel treads of the movable rail end 49 and the fixed rail end 50 are on the same plane for guidance. When the horizontal guide wheel, the horizontal auxiliary wheel 8, the auxiliary rail brake pad 18 or the auxiliary rail brake pad 18 plus the buffer wheel 23 pass back and forth through the treads of the movable rail end 49 and the fixed rail end 50, there is no step to cause impact.

[0058] FIG. 14 is a plan view of the auxiliary rail track change section bending state 45 passing over the straight part of the main rail from above at the intersection 46. 55 is the upper wing extension of the fixed rail end 50 of the auxiliary rail 43. When turning and changing tracks, the upper wing extension 53 of the movable rail end 49 contacts the upper wing extension 55 of the fixed rail end 50 of the auxiliary rail 43, and applies magnetic force or locks, so that the tread has no steps from the movable rail end 49 to the fixed rail end 50.

[0059] FIG. 15 is a plan view of a turnout of the present invention that changes track by swinging the track-changing guide rail left and right. FIG. 16 is a cross-sectional view of FIG. 15. 56 and 57 are horizontal track-changing guide wheels, which are installed on the vehicle, outside the main rail. 58 and 59 are track-changing guide rails that swing left and right, which are installed on the ground. 60, 61, 62 and 63 are the positions of the movable ends of the track-changing guide rails. When the movable end is in the solid line position 60 and 61, the horizontal track-changing guide wheel 56 cooperates with the position 60 of the track-changing guide rail to make the vehicle go straight from left to right. When the movable end is switched to the dotted line position 62 and 63, the horizontal track-changing guide wheel 57 cooperates with the position 63 of the track-changing guide rail to make the vehicle turn from left to right. When the vehicle runs in reverse, the switching is the same. The fixed end and the movable end of the track-changing guide rail are both provided with flares to reduce the impact of the horizontal track-changing guide wheel on the track-changing guide rail. In the turnout section, the main rail can have no gaps at the divergence point 39 and the frog 44, and the main steel wheel 37 can roll smoothly without impact. In the turnout section, the central auxiliary rail 7 is not laid, and the horizontal guide wheel, the horizontal auxiliary wheel 8, the auxiliary rail brake pad 18 or the auxiliary rail brake pad 18 plus the buffer wheel 23 are opened so that they can be re-covered on both sides of the auxiliary rail 7 tread after passing the turnout. The cross-section of the track change guide rail is U-shaped, and the track change guide wheel 56 or 57 is supported and fixed on the vehicle bogie from above, as shown in FIG. 16. The U-shaped can also be turned upside down so that the opening is downward, and the track change guide wheel 56 or 57 is supported and fixed on the bogie from below. At this time, if the bogie moves upward, the upper part of 56 or 57 will contact the concave bottom of the U-shaped, so that the upward movement of the bogie is limited. This is also applicable to FIG. 23 described below.

[0060] FIG. 17 is a turnout of the present invention that swings the auxiliary rail left and right and cooperates with the fixed track-changing guide rail to change the track. 64 and 65 are fixed track-changing guide rails, which cooperate with the horizontal track-changing guide wheel 56 or 57 installed on the vehicle at different times. When the auxiliary rail is swung left and right to the solid line position 40, the vehicle goes straight. Before and after the position 41, the horizontal guide wheel or horizontal auxiliary wheel 8 of the vehicle cooperates with the auxiliary rail for guidance. At the intersection 41, the auxiliary rail is interrupted. At this time, the horizontal guide wheel or horizontal auxiliary wheel 8 of the vehicle is released, and the horizontal track-changing guide wheel 56 of the vehicle cooperates with the track-changing guide rail 64 for guidance. When the auxiliary rail is swung to the dotted line position 45, the vehicle turns and changes the track. Before and after the vehicle is at the position 46, the horizontal guide wheel or horizontal auxiliary wheel 8 of the vehicle cooperates with the auxiliary rail for guidance. At the intersection 46, the auxiliary rail is interrupted. At this time, the horizontal guide wheel or horizontal auxiliary wheel 8 of the vehicle is opened, and the horizontal track-changing guide wheel 57 of the vehicle cooperates with the track-changing guide rail 65 for guidance. In the turnout section, the main rail can have no gap at the divergence point 39 and the frog 44, and the main steel wheel 37 can roll smoothly without impact.

[0061] FIG. 18 is a turnout of the present invention that changes tracks by swinging two auxiliary rails left and right. In the swing section, the swing sections of the two auxiliary rails are higher than the main rails and swing left and right over the main rails. 66 is the straight auxiliary rail in the straight position, indicated by the solid line, for guidance. 67 is the straight auxiliary rail in the turning

position, indicated by the dotted line, for avoiding guidance. 68 is the solid line position and the dotted line position of the straight auxiliary rail. 69 is the turning auxiliary rail in the straight position, indicated by the solid line, for avoiding guidance. 70 is the turning auxiliary rail in the turning position, indicated by the dotted line, for guidance. 71 is the solid line position and the dotted line position of the turning auxiliary rail. The straight auxiliary rail and the turning auxiliary rail are swung left and right by the switch machine at the same time. The solid line positions of 66 and 69 are for straight travel, and the dotted line positions of 67 and 70 are for turning. The difference between the turnout in FIG. 18 and the turnout in FIG. 9 is that FIG. 9 swings one auxiliary rail, and the bending state of the auxiliary rail changes during the swinging, becoming a straight line or a curve. FIG. 18 swings two auxiliary rails, and the bending state of the two auxiliary rails remains unchanged during the swinging, and they only rotate rigidly. The same is that an oblique slit or a zigzag slit can be made at the connection between the movable auxiliary rail and the fixed auxiliary rail, so that the auxiliary rail guide wheel pair or the auxiliary rail action component pair of the vehicle can roll over or pass through the gap of the auxiliary rail guide tread without a step difference, and guide the track change.

[0062] FIG. 19 is a turnout of the present invention that changes the track by swinging the auxiliary rail left and right and cooperating with the outer guide rail and the inner guide rail. FIG. 20 is a cross-sectional view of the single-wheel outer guide rail and the inner guide rail of FIG. 19. 72 and 74 are outer guide rails, and 73 and 75 are inner guide rails. When the auxiliary rail is swung to the solid line position 40, the vehicle goes straight. Before and after the vehicle at the intersection 41, the horizontal guide wheel or horizontal auxiliary wheel 8 of the vehicle cooperates with the auxiliary rail for guidance. At the intersection 41, the auxiliary rail is interrupted. At this time, the horizontal guide wheel or horizontal auxiliary wheel 8 of the vehicle is loosened, and the right wheel of the main steel wheel 37 of the vehicle in FIG. 20 cooperates with the outer guide rail 72 and the inner guide rail 73 for guidance. When the auxiliary rail is swung to the dotted line position 45, the vehicle turns and changes tracks. Before and after the vehicle at the intersection 46, the horizontal guide wheel or horizontal auxiliary wheel 8 of the vehicle cooperates with the auxiliary rail for guidance. At the intersection 46, the auxiliary rail is interrupted. At this time, the horizontal guide wheel or horizontal auxiliary wheel 8 of the vehicle is opened, and the left wheel of the main steel wheel 37 of the vehicle cooperates with the outer guide rail 74 and the inner guide rail 75 for guidance. In the turnout section, the main steel rail can have no gaps at the divergence point 39 and the frog 44, and the main steel wheel 37 can roll smoothly without impact.

[0063] FIG. 21 is a diagram in which the main steel rail 36 is combined with the outer guide rail and the inner guide rail in FIG. 19 and FIG. 20 to form a steel rail 76 with a rail flange. 77 is a rail flange, which limits the rolling direction of the main steel wheel 37 from the left and right sides. Dust and other foreign matter are easily collected on the tread between the left and right rail flanges 77. Therefore, the rail flange 77 has one or two outer rail flanges and inner rail flanges at intervals of a certain distance in the length direction, such as 500 mm, to form a rail flange gap so that dust and other foreign matter can easily flow out of this gap automatically.

[0064] FIG. 22 is a turnout of the present invention that changes tracks by swinging the auxiliary rail left and right and cooperating with the outer guide rails of the two wheels. 78 and 79 are outer guide rails. When the auxiliary rail is swung to the solid line position 40, the vehicle goes straight. Before and after the vehicle is at position 41, the horizontal guide wheel or horizontal auxiliary wheel 8 of the vehicle cooperates with the auxiliary rail for guidance. At position 41, the auxiliary rail is interrupted. At this time, the horizontal guide wheel or horizontal auxiliary wheel 8 of the vehicle is opened, and the main steel wheel 37 of the vehicle cooperates with the outer guide rail 72 and the outer guide rail 79 to guide the left and right wheels. When the auxiliary rail is swung to the dotted line position 45, the vehicle turns and changes tracks. Before and after the vehicle is at position 46, the horizontal guide wheel or horizontal auxiliary wheel 8 of the vehicle cooperates with the auxiliary rail for guidance. At position 46, the auxiliary rail is interrupted. At this time, the horizontal guide wheel or horizontal auxiliary wheel 8 of the vehicle is opened, and the main steel wheel 37 of the vehicle cooperates with the outer guide rail 74 and the outer guide rail 78 to guide the outer sides of the left and right wheels. In the turnout section, the main steel rail can have no gap at the divergence point 39 and the frog 44, and the main steel wheel 37 can roll smoothly without impact.

[0065] FIG. 23 is the auxiliary rail of FIG. 8 of the present invention, with a cross-sectional view of a linear motor stator. FIG. 24 is an oblique view of FIG. 23. 80 is an auxiliary rail of the linear motor stator, with an upper wing. 81 is a horizontal guide wheel. 82 is a brake caliper, supporting the guide wheel 81 and the brake pad 18. 83 is a linear motor rotor. 80 can also be a linear motor rotor, and accordingly, 83 becomes a linear motor stator. The linear motor rotor and the stator cooperate to provide a non-contact drive or brake for the vehicle without mechanical wear. The horizontal guide wheel 81 rolls on both sides of the auxiliary rail from left and right for guidance. The horizontal drive piston 9 can control the squeezing force of the horizontal guide wheel 81 and the brake pad 18 on the auxiliary rail, or leave the auxiliary rail. As a guide wheel, the horizontal guide wheel 81 does not need a large squeezing force, so the horizontal guide wheel 81 can be installed on a spring so that the squeezing force of the brake pad 18 is much greater than the squeezing force of the horizontal guide wheel 81, and the brake pad 18 performs a strong brake. Since the horizontal guide wheel 81 and the brake pad 18 hold up the

upper wing of the auxiliary rail, the vehicle will not derail or overturn without damage. It can also achieve sharp turns and small turning radius.

[0066] The driving and braking of the vehicle are realized by the main steel wheel 37 and the linear motor. The driving and braking of the main steel wheel 37 can achieve an operating speed of 350km/h. However, the friction coefficient between the main steel wheel 37 and the main steel rail 36 is small, and the driving force and braking force that can be generated are small, which is not conducive to rapid acceleration, rapid braking, and rapid uphill and downhill. The driving force and braking force of the linear motor are large, which can achieve better rapid acceleration, rapid braking, and rapid uphill and downhill performance. The brake pad 18 can also perform good braking. In addition to the brake pad 18 and the horizontal guide wheel 81, a horizontal auxiliary wheel 8 with driving and braking functions can also be added. Only relying on the horizontal auxiliary wheel 8, rapid acceleration, rapid braking, and rapid uphill and downhill performance can be achieved. When the vehicle has the drive and braking of the main steel wheel 37, the drive and braking of the horizontal auxiliary wheel 8, the drive and braking of the linear motor, and the braking of the brake pad 18, the vehicle obtains good uniform speed performance, acceleration and deceleration performance, and rapid uphill and downhill performance when slowing and speeding up, and the operating speed of 350km/h can be further improved. The driving and braking of the auxiliary rails also introduce resistance and energy consumption, which are controlled as follows: 1) When the vehicle is running at a constant speed in a straight line on flat ground without rain or snow, the driving force or braking force required by the vehicle is relatively small, or the driving or braking of the main rails and main wheels is sufficient, or the driving force or braking force of the vehicle's main wheels is less than a set value, then only the driving or braking of the main wheels and rails is used to save energy; 2) When accelerating or decelerating suddenly, going up a steep slope, going down a steep slope, or making a sharp turn, the vehicle requires a larger driving force or braking force; or when the rail wheels are wet in rainy or snowy weather, the driving or braking capacity of the main wheels is reduced; or the driving or braking of the main rails and main wheels is insufficient; or when the driving or braking force of the vehicle's main wheels is greater than a set value, the vehicle uses the driving or braking of the main rails and the auxiliary rails at the same time, or only uses the driving or braking of the auxiliary rails to prevent the main wheels from slipping. The set value is related to the slip condition of the main steel wheel, the load of the vehicle, the rain and snow condition of the main steel rail tread, ups and downs, turns, speed, etc., and can be set dynamically or in advance.

[0067] In order to reduce the cost, only one drive is equipped for the main steel rail and the auxiliary rail. Only one brake is equipped for the main steel rail and the auxiliary rail.

[0068] For the main steel wheel without a flange cylindrical tread, a steering mechanism such as a steering wheel can be installed on the vehicle to control the left and right steering of the main steel wheel, so as to facilitate the inspection or maintenance of the vehicle to easily enter and exit the main steel rail track from the outside at the turnout. At this time, the vehicle is like a roller when paving a highway road. The main steel wheel can roll on the surface of concrete or dirt road and can also turn. If the main steel wheel is replaced with a rubber tire, the vehicle becomes a car. The power of the vehicle can be fuel, battery power, external connection power, etc.

[0069] Unlike maglev vehicles, trains using steel wheels are not very sensitive to the load of the vehicle and are suitable for light passenger transport and heavy freight transport. Therefore, the steel wheel vehicle is suitable for establishing a wide railway network.

[0070] For the linear motor auxiliary rail and vehicle structure of FIG. 23 and FIG. 24, the track-changing switch can be the swing auxiliary rail of FIG. 9, the swing track-changing guide rail of FIG. 15, the swing auxiliary rail of FIG. 17 and the track-changing guide rail, the swing auxiliary rail of FIG. 19 and the single-wheel inner and outer guide rails, the swing auxiliary rail of FIG. 21 and the main steel rail flange, or the swing auxiliary rail of FIG. 22 and the two-wheel outer guide rails. In the switch section of these modes, the main steel rail has no movable part, and there can be no gap at the divergence point 39 and the frog 44, so the main steel wheel 37 can roll smoothly without impact.

[0071] FIG. 25 is a diagram of the linear motor auxiliary rail and vehicle structure of FIG. 23, in which the main steel wheel 37 without a flange cylindrical tread is replaced with a main steel wheel 27 with a flange cylindrical tread. On straight and curved tracks, the flange of the main steel wheel does not play a guiding role, and the guidance is carried out by the horizontal guide wheel 81 and the auxiliary rail. The turnout adopts the traditional turnout method of FIG. 7, and the flange plays a guiding role in the turnout section to change tracks. The linear motor auxiliary rail is interrupted and not laid in the turnout section, and the horizontal guide wheel 81 and the brake pad 18 are opened. The driving and braking performance of the main steel wheel 27 with a flange cylindrical tread is the same as that of the main steel wheel 37 without a flange cylindrical tread.

[0072] FIG. 26 is a diamond cross when using a main steel wheel 37 without a flange cylindrical tread, rotating the movable auxiliary rail. The movable auxiliary rail rotates and switches between position 84 and position 85, and cooperates with the horizontal auxiliary wheel for guidance. The relationship between the end face of the movable auxiliary rail and the end face of the fixed auxiliary rail is shown in FIG. 12, FIG. 13 and FIG. 14. The main steel wheel 37 of the vehicle rolls over the frog without a gap and there is no impact.

[0073] FIG. 27 is a diamond intersection when a flan-

geless cylindrical tread main steel wheel 37 is used, and the main steel rail has a rail flange 77. In the diamond intersection section, the central auxiliary rail is not laid, and the horizontal guide wheel, the horizontal auxiliary wheel 8, the auxiliary rail brake pad 18, and the auxiliary rail brake pad 18 plus the buffer wheel 23 are opened. The main steel wheel 37 is guided by the main steel rail rail flange 77. In the entire diamond intersection section, there is no movable part of the track. Before and after the vehicle passes through the diamond intersection section, the horizontal guide wheel or the horizontal auxiliary wheel 8 cooperates with the central auxiliary rail for guidance. A main steel rail has rail flanges 77 on both sides, which can guide the main steel wheel 37 to roll through the diamond intersection section. The main steel rail flange 77 can also be replaced with an outer guide rail 72 and an inner guide rail 73 to guide the main steel wheel 37.

[0074] FIG. 28 is a plan view of a crossing where a track using a flangeless cylindrical tread main steel wheel 37 intersects with a highway plane. 85 is a highway with two lanes. The dotted line is the dividing line of the lanes, and the solid lines parallel to it are the two side lines of highway 85. When the rail passes through highway 85, no auxiliary rail 7 is laid. One of the main rails 36 is replaced with a rail 76 with rail flanges 77 on both sides, and the other is still the main rail 36. One rail 76 can guide the main steel wheel 37 to roll through the highway intersection. The height of the tread of rail 76 is the same as that of the main rail 36, so the height of the rail flange 77 is higher than that of the main rail 36. When a concrete road surface is laid outside the rail, the concrete road surface is at the same height as the rail flange 77 and the tread, and there is a slope from the rail flange 77 to the tread of the main rail 36. Before and after the train passes through the highway intersection, the horizontal guide wheel or the horizontal auxiliary wheel cooperates with the auxiliary rail for guidance. When passing through the highway intersection, because no auxiliary rail is laid, the horizontal guide wheel and the horizontal auxiliary wheel 8 are opened. In the highway intersection, the rail flanges 77 on both sides of the rail 76 guide the main steel wheel 37. The main steel rail flange 77 can also be replaced with an outer guide rail 72 and an inner guide rail 73 to guide the main steel wheel 37.

[0075] In the crossing section of FIG. 28, when the wheel of a car or bicycle rolls over the flange 77 and the tread, the height difference between the flange 77 and the tread has an impact on the wheel. In order to reduce the impact, the height of the flange rising from the tread should be minimized, but when the flange height is too small or equal to zero, the guiding effect of the flange becomes worse. At this time, a steering mechanism can be installed on the vehicle to control the main steel wheel 37 to make the vehicle go straight. Or use a camera to dynamically monitor the vehicle's pointing state and control the main steel wheel 37 to make the vehicle go straight. In this way, after the main steel wheel 37 rolls over the highway intersection section with a very small flange height, the horizontal guide wheel or the horizontal auxiliary wheel can be re-mounted on both sides of the auxiliary rail. In order to smoothly mount the auxiliary rail, the end face of the auxiliary rail is made into a horizontal pointed wedge shape, and a horizontal bell mouth is installed in front of the horizontal guide wheel or the horizontal auxiliary wheel of the vehicle. The pointed wedge and the bell mouth are used for guidance, which can absorb a large error of the vehicle deviating from the center of the rail. The pointed wedge can also be made into a rolling cylinder with a smaller diameter, which is also somewhat elastic to reduce impact or friction. This approach is also suitable for the aforementioned turnouts and diamond crossing sections.

[0076] For the main steel wheel 27 with a flange cylindrical tread in FIG. 25, no auxiliary rail is laid in the crossing section, and the horizontal guide wheel or horizontal auxiliary wheel of the train is opened. The flange 29 of the main steel wheel 27 cooperates with the rail 1 for guidance. Before and after the train passes through the crossing, the horizontal guide wheel or horizontal auxiliary wheel cooperates with the central auxiliary rail for guidance. In the crossing section, the guidance is the same as that of traditional railways.

[0077] The horizontal auxiliary wheel 8 of the present invention in FIG. 1 and 8 can also act on the main rail. FIG. 29 is a sectional view of the scene of the flangeless main steel wheel 37 rolling and guiding on the main rail 36. FIG. 30 is an oblique view of FIG. 29. 86 is a horizontal guide wheel installed near the main steel wheel at the lower part of the vehicle, one on each side, located on the inner side of the two main steel rails 36, rolling on the surface of the inner side of the upper wing of the main steel rail 36 to guide. Therefore, the inner surface becomes the inner tread of the guide. 87 is the flange of the horizontal guide wheel, which is below the upper wing of the main steel rail 36 to prevent the vehicle from being lifted. 88 is a supporting component of the horizontal guide wheel. Here, the main steel wheel 37 without a flange cylindrical tread and the horizontal guide wheel 86 are equivalent to the decomposition of the main steel wheel 27 with a flange cylindrical tread in FIG. 6. The main steel wheel 37 without a flange cylindrical tread is an independent rolling wheel pair, rolling on the main steel rail 36 to support the weight of the vehicle. Guidance is carried out by the rolling cooperation of the horizontal guide wheel 86 and the inner tread of the main steel rail 36. The tread of the horizontal guide wheel 86 is a cylindrical surface, a conical surface or a curved surface of other complex shapes, so as to cooperate with the inner tread of the main steel rail 36 and the inner tread at the turnout. The gauges of the two main rails 36 have laying tolerances. In order to absorb the tolerances, the support component 88 of the horizontal guide wheel is installed on an elastic support body, which can move left and right to a certain extent, but the movement is limited to ensure the guidance. The elastic support body can be a coil spring or an

elastic plate. The elastic pressure of the horizontal guide wheel 86 on the inner tread of the main rail 36 does not need to be very large, and the horizontal guide wheel 86 can be rotated without sliding with the main rail 36. In order to pass through the narrow space at the point rail 31 and the frog 35 of the traditional steel rail turnout in FIG. 7, the diameter of the horizontal guide wheel 86 is generally less than 80mm, which is relatively small. In order to smoothly roll over the point rail 31 of the turnout, there may be no wheel flange 87. In order to maintain sufficient mechanical strength, the horizontal guide wheel 86 can be just an axle, and its bearing mechanism is in the support component 88 of the horizontal guide wheel. When the movable point rail frog is used in the turnout, the harmful space is small, and the impact when the main steel wheel 37 and the horizontal guide wheel 86 roll over is small. The tread material of the horizontal guide wheel 86 is a wear-resistant material of metal alloy or artificial stone. Correspondingly, the inner tread of the upper wing of the main rail 36 is made of metal alloy material or has undergone wear-resistant surface treatment. Because it is a cylindrical tread main steel wheel 37, the tread of the main rail 36 can be wider, so the joint in the length direction of the rail can be made into a welded seam, an oblique seam, a zigzag seam, or a straight seam. The inner tread of the main rail 36 can also be made into a welded seam, an oblique seam, a zigzag seam, or a straight seam.

[0078] The horizontal guide wheel 86, including the wheel flange 87, has a relatively small diameter and relatively weak mechanical strength. There may be several horizontal guide wheels 86 to increase strength. In addition, in order to have great mechanical strength, part or all of the horizontal guide wheels 86 may be replaced with non-rotating solid bars or solid plates, and the wheel flange 87 may become a unidirectional hook extending below the upper wing of the main rail 36 to prevent the vehicle from being lifted.

[0079] In FIG. 29, an auxiliary rail of a linear motor may also be laid in the center of the two main rails 36. The auxiliary rail has a stator or rotor of the linear motor; accordingly, a matching rotor or stator of a linear motor higher than the tread of the main rail is installed on the vehicle. The driving force and braking force of the linear motor are large, which is conducive to steep uphill and steep downhill.

[0080] For the structures of FIG. 29 and FIG. 30, the turnout may adopt the structure of FIG. 15 for changing tracks by swinging the track-changing guide rail left and right. After the horizontal track change guide wheel of the train enters the track change guide rail, before the main steel wheel enters the divergence point 39 and the frog 44, the horizontal guide wheel 86 is raised to a level higher than the main rail tread, and the horizontal track change guide wheel cooperates with the track change guide rail for guidance. After the main steel wheel rolls over the divergence point 39 and the frog 44, the horizontal guide wheel 86 is lowered to cooperate with the inner tread of the upper wing of the main steel rail for guidance, and the vehicle continues to run. The horizontal guide wheel 86 is raised to change the track. The turnout can also use rails with outer rail flanges and/or inner rail flanges, or outer guide rails and inner guide rails to guide the main steel wheel 37 to change the track. At this time, the horizontal guide wheel 86 should be raised to a level higher than the rail flange or guide rail so that it can pass over from above without collision. In order to smoothly raise the horizontal guide wheel 86, there can be no wheel flange 87. In the turnout section of these methods, the main rail has no movable parts, and there can be no gaps at the divergence point 39 and the frog 44, so the main steel wheel 37 can roll smoothly without impact.

[0081] The main steel wheel 37 of FIG. 29 without flange cylindrical tread can also be replaced with the main steel wheel without flange conical tread, and the conical tread forms a rigid wheel pair. When the vehicle is running in a straight line and a curve, the rigid wheel pair of the conical tread has automatic steering and turning functions, and the horizontal guide wheel 86 is generally not guided. Therefore, in order to simplify the mechanism, the horizontal guide wheel 86 can be installed on a rigid support body, and it is not necessary to be installed on an elastic support body. However, when the serpentine motion of the vehicle's ultra-high-speed straight-line operation increases, when turning at ultra-high speed, when turning at a small radius, or when the automatic steering performance of the rigid wheel pair of the conical tread is insufficient, the horizontal guide wheel 86 contacts the inner tread of the main rail and also participates in guiding. In order to avoid sliding friction, the horizontal guide wheel 86 can be installed on the elastic support body in advance, and the horizontal guide wheel 86 has a smaller elastic pressure on the inner tread of the main rail, so that the horizontal guide wheel 86 rolls on the inner tread of the main rail without sliding. In the traditional steel rail switch section of FIG. 7, the horizontal guide wheel 86 cooperates with the pointed rail 31 to change tracks, whether it is installed on a rigid support body or an elastic support body. For the main steel wheel with a conical tread, the upper surface tread of the main steel rail 36 is narrow, and the joints in the length direction of the main steel rail are welded seams, oblique seams, or straight seams, and the serrated seams are difficult to make.

[0082] Compared with the flange of the main steel wheel, the horizontal guide wheel 86 in FIG. 29 and FIG. 30 is more complicated, but has many advantages. The flange of the main steel wheel mainly serves to guide the track change and prevent derailment, but the friction noise of the flange guide is relatively large. In the straight and curved operation of the vehicle, in order to avoid the flange guide, a rigid wheel pair with a conical tread is used. The derailment prevention ability of the flange is weak. When turning at high speed or serpentine motion at high speed, the flange is more likely to climb to the tread on the upper surface of the steel wheel, and then derail.

Therefore, the speed limit of the train is relatively strict. The horizontal guide wheel 86 has strong and smooth guiding force, low friction noise, strong derailment prevention ability, and is also suitable for the guidance and track change operation of the cylindrical tread independent rolling wheel pair in straight lines, curves and switches. The vertical tread structure of the horizontal guide wheel 86 makes it difficult for the horizontal guide wheel to climb onto the upper surface tread of the steel wheel, so it is suitable for high-speed turning. The independent rolling wheel pair of the cylindrical tread is suitable for small radius turning. The cylindrical tread greatly reduces the serpentine motion, so the speed of the conical tread of 350km/h can be further increased. In addition, when the horizontal guide wheel 86 is applied to the conical tread rigid wheel pair, it is also beneficial to enhance the prevention of serpentine motion derailment, to enhance the prevention of high-speed turning derailment, and to enhance the prevention of small radius turning derailment.

[0083] The horizontal guide wheel 86 is lower than the main rail. When passing through the narrow groove at the crossing, if there is a foreign object in the narrow groove, it is difficult for the horizontal guide wheel 86 to pass smoothly. Therefore, a firm pointed wedge can be installed on the vehicle to push away the foreign object so that the horizontal guide wheel 86 can pass through the narrow groove smoothly.

[0084] For the horizontal guide wheel 86 on the inner side of the main rail, a horizontal driving wheel or brake pad can be installed on the vehicle, and on the outer side of the main rail, the main rail is squeezed from the inner and outer sides in cooperation with the horizontal guide wheel 86 to achieve driving or braking. Horizontal driving wheels or brake pads can also be installed on both the inner and outer sides of the main rail to form a pair, squeeze the main rail, and achieve driving or braking. The horizontal driving wheel or brake pad is raised by a dynamic adjustment mechanism in the turnout section, diamond intersection section, crossing section, and temperature expansion regulator section to avoid collision with the main rail or other objects. In order to absorb the gauge tolerance and straightness tolerance of the two main rails, the squeezing mechanism allows the horizontal guide wheel 86 and the horizontal driving wheel or brake pad to move left and right as a whole in a certain amount. The applied squeezing force can be greater than the vehicle weight, so the horizontal driving wheel can provide a driving force or braking force greater than the main steel wheel. When the driving force or braking force is not needed, the squeezing force can be reduced to reduce rolling resistance. The dynamic adjustment mechanism raises the horizontal driving wheel or brake pad, which may fail, and then it may collide with the main rail or other objects, causing disasters. In order to avoid disasters caused by failures, a rising safety block is installed on the track in front of the turnout section, diamond intersection section, crossing section, and temperature expansion regulator section. When the vehicle is running, the collision safety mechanism of the horizontal driving wheel or brake pad collides with the rising safety block, so that the horizontal driving wheel or brake pad automatically releases the main rail and rises, and then the vehicle continues to run in the raised position, so that it will not hit the main rail or other objects. The safety block can be a fixed spare part. The collision safety mechanism can be a mechanical switch. After the vehicle passes through the turnout section, diamond intersection section, crossing section, and temperature expansion regulator section, the horizontal driving wheel or brake pad on the vehicle can collide with the descending safety block installed on the track again, or trigger optical, electrical, magnetic and other sensors, and automatically or manually operate to descend to the outside or inside of the main rail to guide, prevent derailment, or squeeze the main rail for driving or braking.

[0085] The two horizontal guide wheels 86 in FIG. 29 and FIG. 30 are located on the inner side of the two main rails 36. It can also be replaced to be located on the outside of the two main rails 36, and rolling on the outer tread of the upper wing of the main rail 36 for guidance. However, there are problems when running on traditional rails, because the wheel flange of the traditional steel wheel is the inner wheel flange, and the rail turnout, temperature expansion regulator, etc. are built on the basis of the inner side matching. Therefore, it is necessary to simply change to the turnout, temperature expansion regulator, etc. that match the outer side.

[0086] Two horizontal guide wheels 86 can also be installed on the train of FIG. 8. However, in order to avoid mutual interference with the guidance of the auxiliary rail, when the auxiliary rail exists, it is guided by the auxiliary rail. The horizontal guide wheel 86 moves upward or inward away from the main rail, or is removed, and no guidance is performed. When the horizontal guide wheel 86 moves inward away from the main rail, the turnout of FIG. 7 can be used. When the horizontal guide wheel 86 moves upward away from the main rail or is removed, the turnouts of FIG. 9 to FIG. 15, FIG. 17 to FIG. 19, and FIG. 22, the diamond intersection of FIG. 26 to FIG. 27, and the crossing of FIG. 28 can all be used. When the train runs on a conventional steel rail without an auxiliary rail, the horizontal guide wheel 86 is used for guidance, and it can also be guided by a conventional turnout as shown in FIG. 7. In this way, the new train of the present invention can run on the new track of the present invention or on a conventional track, and has good interchangeability. However, the new turnout, diamond intersection, and crossing of the present invention other than FIG. 7 cannot allow a conventional train with flanged steel wheels to pass through, and are not interchangeable.

[0087] The support component 88 of the horizontal guide wheel 86 in FIG. 29 and FIG. 30 is installed at the lower part of the train bogie, and the left and right horizontal guide wheels 86 form a pair. A bogie has two pairs of front and rear horizontal guide wheels 86 to

prevent derailment. On the straight track, all wheels are parallel and roll forward and backward. But on the curve, more consideration is needed.

[0088] The main steel wheel in FIG. 31 is a conical tread rigid wheel pair or a cylindrical tread independent rolling wheel pair. The horizontal guide wheel pair 86 rotates as a whole with the steering wheel pair. The steering of the front and rear steering wheel pairs is opposite. 89 is the rotation center of the steering wheel pair. 90 is the rotation center of the track or the steering wheel pair. 91 is a train bogie.

[0089] The main steel wheel in FIG. 32 is an independent rolling wheel with a cylindrical tread. The horizontal guide wheel pair 86 rotates with the separate steering wheel or does not move. The left and right steering wheels turn in the same direction, but the steering angles are slightly different. The front and rear steering wheels turn in opposite directions. 92 is the rotation center of the track or steering wheel. The turning of the left and right steering wheels reduces the vertical distance between the left and right steering wheels. As long as the main steel rail or the main steel wheel has sufficient width, the cylindrical tread of the main steel wheel can always roll on the upper surface of the main steel rail. In the curved motion of FIG. 31 and FIG. 32, the outer horizontal guide wheel 86 of the train may be squeezed on the inner side of the outer main steel rail.

[0090] The main steel wheel in FIG. 33 is a rigid wheel pair with a conical tread or an independent rolling wheel pair with a cylindrical tread. The horizontal auxiliary wheel pair 8 rotates as a whole with the steering wheel pair. The front and rear steering wheel pairs turn in opposite directions. The horizontal auxiliary wheel pair 8 can also move horizontally left and right as shown in FIG. 34. When the main steel wheel is a cylindrical tread, the horizontal auxiliary wheel pair 8 can also be stationary.

[0091] The main steel wheel in FIG. 34 is an independent rolling wheel with a cylindrical tread. The horizontal auxiliary wheel pair 8 follows the rotation of the steering wheel to move left and right, or it can be stationary. The left and right steering wheels turn in the same direction, and the steering angles are slightly different. The front and rear steering wheels turn in opposite directions. The turning of the left and right steering wheels reduces the vertical distance between the left and right steering wheels. Because the horizontal auxiliary wheel pair 8 is guided by the auxiliary rail, the main steel rail does not participate in the guidance, so the horizontal auxiliary wheel pair 8 does not need to rotate or move, but is only fixed, and there is no guidance problem. As long as the main steel rail or the main steel wheel has enough width, the cylindrical tread of the main steel wheel can always roll on the upper surface of the main steel rail.

[0092] When the main steel wheels in FIG. 29 and FIG. 30 are conical treads and rigid wheel pairs, similar to the traditional train structure, the rigid wheel pairs are installed at the bottom of the train bogie, and the train body is installed on the bogie. Usually, one train body is installed on two bogies to facilitate turning at the curve of the rail, as shown in FIG. 35. 93 is the train body, and 94 is the steering shaft between the body and the bogie. One bogie has two wheel pairs. The two wheel pairs can be dynamically adjusted to rotate with each other so as to smoothly pass the curve of the main rail. The horizontal auxiliary wheel pair 8 is also installed at the bottom of the bogie, and the left and right horizontal auxiliary wheel pairs 8 form a pair. At this time, at the turning point, the wheelbase of the main steel wheel is the same as the straight section, and the laying gauge of the main rail can be slightly increased so as to make good use of the diameter difference of the conical tread to achieve a smaller turning radius.

[0093] For cylindrical tread wheels, one bogie can also have two independently rotating wheel pairs. An independent rotating wheelset has two wheels on the left and right sides, which can dynamically adjust a steering angle as a whole like a rigid wheelset, so as to smoothly pass through the curve of the main steel rail. At this time, at the turning point, the wheelbase of the main steel wheel is the same as the straight section. The laying gauge of the main steel rail can also be the same as the straight section.

[0094] The left and right wheels of an independent rotating wheelset can also dynamically adjust the steering angles separately like the steering wheels of a car, so as to smoothly pass through the curve of the main steel rail. At this time, at the turning point, the wheelbase of the main steel wheel is smaller than the straight section. When the horizontal guide wheelset 86 is used and rotates with the turning of the independent rotating wheelset, the laying gauge of the main steel rail can also be smaller than the straight section, so as to cooperate with the horizontal guide wheelset 86.

[0095] When the length of the car body is short, because it is easy to turn, a bogie is sufficient, and it can be integrated with the car body, and the car body also becomes a bogie. When the train turns, the car body can also be a swing type like a traditional train, or the track has a curved outer rail superelevation.

[0096] As shown in FIG. 31, FIG. 33 and FIG. 35, at the main rail bend, the conical tread rigid wheelset or the cylindrical tread independent rolling wheelset turns as a whole, and the other wheelset at the rear turns in the opposite direction as a whole. As shown in FIG. 33 and FIG. 35, the cylindrical tread independent rolling wheelset turns independently, and the other wheelset at the rear turns independently in the opposite direction. On a bogie, there is a pair of horizontal guide wheels at the front and rear, which rotate with the steering wheelset or remain stationary. On a bogie, there is a pair of horizontal auxiliary wheels at the front and rear, which rotate, move horizontally, or remain stationary with the steering wheel set.

[0097] On March 16, 2022, Japan's Shinkansen high-speed railway train derailed during an earthquake. Originally, the wheel flange of a train has the function of

preventing the wheel from derailing laterally, but there is a smooth curve transition section between the wheel flange and the wheel tread, so the derailment prevention ability is poor. Japanese patent JP4723282B2 invented a derailment prevention guardrail, which is widely used in central Japan. The patent adds two auxiliary rails as guardrails on the inner side of the traditional left and right rails, and the upper surface of the guardrail is slightly higher than the tread of the traditional rail. When the train wheel moves inward and is about to derail, the wheel flange is blocked by the guardrail and cannot derail. Because the upper surface of the guardrail is higher, the derailment prevention force of the guardrail on the inner side of the wheel flange is greater than the derailment prevention force of the traditional rail on the outer side of the wheel flange. Japanese patent JP5297217B2 invented a rail inversion prevention device, which is widely used in eastern Japan. This patent does not have a derailment prevention function, but after derailment, the escape protection piece installed on the train bogie is blocked by the traditional rail, so that the derailed train cannot escape the track to the left or right to avoid further disasters. Because the traditional rail may be subjected to a large lateral force to the inside when blocking, and it will be reversed from the standing posture, so this patent invented a traditional rail inversion prevention device. Another method is widely used in western Japan. This method adds a central track as a guardrail in the middle of the traditional left and right rails. The central track does not have a derailment prevention function, but after the wheel derails inward, the wheel is blocked by the central track and cannot continue to increase the derailment or escape the track to avoid further disasters.

[0098] The traditional wheel flange derailment prevention and the structural design of the three earthquake countermeasures implemented in Japan mentioned above have a common feature, that is, they do not prevent the upward movement of the train wheels. When there is a large earthquake, a strong crosswind, or a strong train running vibration, the train wheels may jump up or lift up, causing the train to derail or overturn. JP4405904B2 uses a brake hook, which rotates 90 degrees to descend and hold the upper wing of the central auxiliary rail I-shaped, and brakes to prevent the train from moving upward. However, the descending movement of the brake hook needs to be automatically controlled in time, and once the control fails, the brake hook may hit the main rail at the turnout, causing the train to derail.

[0099] Structural design of the present invention, on the basis of traditional railway rail steel wheel, not only has the function of stopping train from moving downward, leftward, rightward, and also has the function of stopping the upward motion of railway wheel, thereby realizes that train does not derail, does not reverse overturning, makes train can run smoothly under more and more difficult conditions, improves the operation potential of train. The derailment prevention member that the present invention is installed on the vehicle is a fixing piece, and it is impossible to bump into the main rail.

[0100] FIG. 36 is a structural design of the present invention. 1 is a conventional rail. 95 is a sleeper. 3 is a conventional train steel wheel. 4 is the tread of the steel wheel, which is in rolling contact with the upper surface of the rail. The diameter of the tread is different along the thickness of the steel wheel, forming a conical tread. 5 is the wheel flange of the steel wheel. 6 is the axle. The left and right steel wheels 3 and the axle 6 are rigidly fixed together to form a wheel pair, which becomes a rigid wheel pair. The present invention adds an auxiliary rail and a derailment prevention component on the basis of the conventional rail and steel wheel structure. 96 is the auxiliary rail of the present invention, which is laid in the center of the conventional two rails 1 and has an I-shaped cross section. The I-shaped upper wing 97 of the auxiliary rail 96 is higher than the upper surface of the rail 1. The I-shaped lower wing 98 is fixed to the sleeper 95 by the auxiliary rail fixing member, and the fixing method can adopt the fixing method of the conventional rail, or the device described in the patent JP5297217B2. The I-shaped lower wing 98 and the auxiliary rail fixing member are lower than the upper surface of the rail 1. A pair of derailment prevention components 99 are installed on the train or the bogie of the train. The derailment prevention component 99 has a horizontal claw 100 extending below the I-shaped upper wing 97 of the auxiliary rail 96, holding the upper wing of the auxiliary rail I-shaped. The lower surface of the horizontal claw 100 is higher than the upper surface tread of the rail 1. The derailment prevention component 99 is installed on the derailment prevention component support body 101 of the train or the bogie of the train.

[0101] The horizontal claw 100 has a certain distance from the I-shaped waist of the auxiliary rail 96 in the horizontal direction, and generally does not contact, so as not to interfere with the train's serpentine oscillation or left and right movement when the train turns. However, the distance is not very large. When the train moves left and right and is likely to derail, the horizontal claw 100 contacts the I-shaped waist, or the vertical surface of the root of the horizontal claw contacts the end surface of the I-shaped upper wing to prevent derailment. In addition, the upper surface of the horizontal claw 100 generally does not contact the lower surface of the I-shaped upper wing 97. Due to a large earthquake, a strong crosswind, a strong train running vibration, a large train moving left and right, etc., the train may jump up or lift up, and the upper surface of the horizontal claw 100 contacts the lower surface of the I-shaped upper wing 97 to prevent the train from moving upward. In this way, the train will not derail or turn over.

[0102] In the railway network, the train will pass through train switches, diamond intersections, crossings, etc. At this time, all parts above the tread of the train wheel need to pass over the upper surface tread of the rail 1. Since the lower surface of the horizontal claw 100 is

higher than the upper surface of the rail 1, it will not collide with the rail when passing over the upper surface of the rail 1. Since the auxiliary rail I-shaped lower wing 98 and the auxiliary rail fixing piece are lower than the tread of the rail 1, the lower surface of the horizontal claw 100 will not collide with them when passing over the I-shaped lower wing 98 and the auxiliary rail fixing piece of another auxiliary rail. The auxiliary rail I-shaped lower wing and the auxiliary rail fixing are lower than the tread of the traditional rail, and are also applicable to auxiliary rails 7, 17 and 80. In order to prevent the horizontal claw 100 from hitting the auxiliary rail in the other direction, the auxiliary rail 7 is not laid in the train turnout or diamond intersection section, as shown in FIG. 37, and the horizontal claw 100 can pass smoothly, but there is no derailment prevention function. At this time, the auxiliary rails 102 or 103 with upper wings can be laid on both outer sides of the turnout, as shown by the dotted lines in the FIG., and the bogie is further installed with horizontal claws, extending below the upper wings. When the bogie is lifted, the horizontal claw hits the upper wing and the lifting is prevented. The horizontal claw cooperates with the upper wing of the auxiliary rail 102 or 103 to prevent the excessive lateral movement of the bogie to the left or right. The auxiliary rail 102 can also be extended, as shown in FIG. 15, to swing positions 61 and 63 to adapt to the train going straight or turning. On the two inner sides of the rail 1, left and right auxiliary rails can also be further laid to enhance the prevention of excessive left and right movement of the bogie. In addition, in the railway turnout or diamond crossing section, the auxiliary rail 7 can swing left and right, such as FIG. 11 or FIG. 26. In order to cross the upper surface of the rail 1, the lower wing of the auxiliary rail I-shaped and the waist part below the upper surface of the rail 1 are cut off, leaving only the upper wing 97 and the waist part above the upper surface of the rail 1, crossing the upper surface of the rail 1, and switching tracks, as shown in FIG. 12. In this way, the auxiliary rail 7 has no interruption, the horizontal claw 100 can pass smoothly, and it also has a derailment prevention function.

[0103] The train wheels have been used for a long time. Due to wear and repair processing, the wheel tread diameter gradually decreases, and the height of the horizontal claw 100 also decreases accordingly. In order to prevent the horizontal claw 100 from colliding with the rail 1, the design height of the horizontal claw 100 should have a design margin in advance. Or when the wheel tread diameter becomes smaller and the support body 101 drops, the derailment prevention component 99 is installed by sliding adjustment to keep the height of the horizontal claw 100 unchanged.

[0104] The horizontal claw 100 of derailment prevention member is a simple component, low cost, and can also be replaced into a more complicated horizontal guide wheel, horizontal drive wheel, horizontal brake wheel, brake pad, so as to realize the effect of strong guiding, strong driving, strong braking. At turnout, diamond intersection, crossing etc., the positional relationship of auxiliary rail 96 and horizontal claw 100 is similar to the positional relationship of auxiliary rail and horizontal auxiliary wheel. Horizontal claw 100 can also be replaced into a wheel or axle of vertical rolling, so as to contact with the lower surface rolling of I-shaped upper wing 97.

[0105] The auxiliary rail 96 is a central auxiliary rail, which can also be replaced by two auxiliary rails, located on the inside or outside of the traditional rail. Correspondingly, each auxiliary rail is equipped with one or a pair of horizontal claws of the derailment prevention component on the train or the train bogie. The two auxiliary rails have a large spacing. Although there is one more auxiliary rail, the cost increases, but the blocking torque to restrain the upward movement of the train is greater and the blocking effect is better.

[0106] FIG. 38 shows that two auxiliary rails are laid on the outside of the main rail, and two derailment prevention claws cooperate with them to hold the two auxiliary rails to achieve strong derailment prevention. 104 is a sleeper. 105 is an auxiliary rail with an upper wing and a vertical surface. The cross section is not an I-beam or a T-beam, and it is fixed on the sleeper. 106 is a derailment prevention claw. 107 is a derailment prevention component support body, which is fixed on the bogie or directly fixed on the car body. Similar to FIG. 36, the left and right derailment prevention claws 106 hold the upper wings of the two auxiliary rails 105 respectively to prevent the bogie or the car body from moving left and right and upward, thereby preventing derailment. There is a gap between the two derailment prevention claws 106 and the two auxiliary rails 105, which are generally not in contact and do not affect the snaking movement of the vehicle. The derailment prevention claws 106 are higher than the upper surface of the main rail and will not collide at the turnout. Compared with the one auxiliary rail in FIG. 36, the two auxiliary rails in FIG. 38 cooperate with the left and right derailment prevention claws 106 to generate a greater torque to prevent the vehicle from rolling over. Of course, the cost of two auxiliary rails is higher than that of one.

[0107] The two auxiliary rails may have a stator or rotor of a linear motor, and a corresponding rotor or stator of a linear motor may be provided on the vehicle bogie or car body above or to the side of the auxiliary rails. Non-contact driving or braking is achieved between the stator and rotor of the linear motor.

[0108] The auxiliary rail can also be a power supply rail, with a conductive contact slide or conductive contact wheel extending from the bogie or car body, and sliding or rolling contact with the power supply rail to conduct electricity. For safety, the upper surface of the power supply rail of the auxiliary rail is an insulator, and the lower surface of the upper wing or the vertical surface is used as a conductive surface.

[0109] FIG. 39 shows two auxiliary rails laid on the outside of the main rail, and two derailment prevention

claws are respectively embraced by the two auxiliary rails to achieve strong derailment prevention. 108 is a sleeper. 109 is an auxiliary rail, which has an upper wing and a vertical surface, and the cross-section is an I-beam, which is fixed on the sleeper. 110 is a derailment prevention claw. 111 is a derailment prevention component support body, which is fixed on the bogie or directly fixed on the car body. Compared with FIG. 38, the left and right derailment prevention claws 110 are respectively on the inner side of the two auxiliary rails 109, and are embraced by the upper wing of the auxiliary rail, preventing the bogie or car body from moving left and right and upward, thereby preventing derailment. There is a gap between the two derailment prevention claws 110 and the two auxiliary rails 109, which are generally not in contact and do not affect the hunting oscillation of the vehicle. The derailment prevention claws 110 are higher than the upper surface of the main rails and will not collide at the turnout. On the outside of the two auxiliary rails 109, derailment prevention claws 106 can also be set at the same time to increase the strength, but the cost is also higher.

[0110] For the main steel wheel with a flangeless cylindrical tread, the above-mentioned railway turnouts are all swung left and right to achieve the train track change. The following invention proposes that the rails do not swing, and only the turning operation is performed on the train vehicle to achieve the track change. FIG. 40 and FIG. 41 are such a turnout. 112 and 113 are track change guide rails, which are installed on the ground and fixed without swinging. 114 and 115 are track change guide wheels, which are installed on the vehicle or vehicle bogie, outside the main rails, and move up and down to change the track. For example, when a train vehicle travels from left to right, the track-changing guide wheel 114 rises and enters the U-shaped groove of the track-changing guide rail 112 to cooperate, and the track-changing guide wheel 115 descends and does not enter the U-shaped groove of the track-changing guide rail 113 to cooperate, so that the vehicle can go straight. If the track-changing guide wheel 114 descends and does not enter the U-shaped groove of the track-changing guide rail 112 to cooperate, and the track-changing guide wheel 115 rises and enters the U-shaped groove of the track-changing guide rail 113 to cooperate, the vehicle is turned. When a train vehicle travels from right to left, the same rise and fall of the track-changing guide wheels 114 and 115 is also performed. When going straight, the horizontal force between the track-changing guide wheel 114 and the track-changing guide rail 112 is not large, and is equal to zero in theory, so the speed of the train vehicle going straight can be very high, which is basically the same at the turnout and at the non-turnout. But when turning, there is a horizontal force between the track-changing guide wheel 115 and the track-changing guide rail 113, and the speed needs to be slowed down. The difference between FIG. 41 and FIG. 16 is that the U-shaped groove of the track change guide rail opens downward. This is conducive to preventing the train from being lifted. In the turnout section, the main rail can have no gaps at the divergence point 39 and the frog 44, and the main steel wheel 37 can roll smoothly and without impact. In the turnout section, the central auxiliary rail 7 is not laid, and the horizontal guide wheel, the horizontal auxiliary wheel 8, the auxiliary rail brake pad 18 or the auxiliary rail brake pad 18 plus the buffer wheel 23 are opened so that they can be re-covered on both sides of the tread of the auxiliary rail 7 after passing the turnout.

[0111] The turnout of FIG. 42 is similar to FIG. 40, but at the track outside the turnout, the auxiliary rail is changed from one to two 116, which are respectively on the outside of the main rail, and their shapes are the same as the track change guide rails 117 and 118, which are U-shaped steels of the track change guide rails 112 and 113, and open downward. At the track outside the turnout, the left and right guide wheels 119 and 120 are switched to the upper part to cooperate with the U-shaped groove of the auxiliary rail 116 for straight or curved guidance. At the turnout track, one of the guide wheels 119 and 120 remains on the top and cooperates with the U-shaped groove of the track-changing guide rail 117 or 118 to guide the track-changing. Another switches to the bottom, leaving the U-shaped groove of the track-changing guide rail 117 and 118.

[0112] FIG. 43 is a cross-sectional view of a turnout. Similar to FIG. 41, the track change guide rails 117 and 118 are fixed on the sleepers.

[0113] In the cross-sectional view of the turnout in FIG. 44, the left and right guide wheels 121 and 122 are not switched up and down, but are switched horizontally. In the turnout track section of FIG. 40, before the vehicle enters the turnout, one of the left and right guide wheels 121 and 122 is switched horizontally to a position away from the wheel, and cooperates with the U-shaped groove of the track change guide rail 112 or 113 to guide the track change. The other is switched horizontally to a position close to the wheel, leaving the U-shaped groove of the track change guide rails 117 and 118.

[0114] FIG. 45 is another turnout whose track is not switched. 123 and 124 are left and right track change guide walls, fixed on the ground such as sleepers. 125 and 126 are left and right guide wheels, installed on the vehicle or vehicle bogie, extending or retracting from the vehicle to the left and right to facilitate track change. 127, 128 and 129 are the interruptions of the central auxiliary rail 7. In the straight sections of 127 and 128 and the turning sections of 127 and 129, there is no central auxiliary rail, but the main rail has a rail flange, as shown in FIG. 46. FIG. 47 is an enlarged view of the divergence point 39. 76 is a rail with a rail flange. 77 is a rail flange. 131 is a straight rail flange. 132 is a turning rail flange. 133 is the outer boundary of the rail flange. 134 is the Y-shaped tread of the rail divergence point 39.

[0115] When the train vehicle reaches the straight fork at 127 from left to right, the matching guide of the central auxiliary rail 7 and the horizontal guide wheel pair 8 is

released, and the horizontal guide wheel pair 8 opens. The track change guide wheel 125 retracts and leaves the track change guide wall 123 to guide, while the track change guide wheel 126 extends out to contact the track change guide wall 126 for guidance, so that the cylindrical main steel wheel 38 cooperates with the straight rail flange 131 to guide through the divergence point tread 134 and travel to the position 128. At the position 128, the cooperation guidance of the main steel wheel 38 and the rail flange is switched back to the cooperation guidance of the central auxiliary rail 7 and the horizontal guide wheel pair 8, and the turnout is completed. The horizontal guide wheel pair 8 is again set on both sides of the auxiliary rail 7 tread. When the train vehicle reaches the turning fork 127 from left to right, the track change guide wheel 125 extends out to contact the track change guide wall 123 for guidance, while the track change guide wheel 126 retracts and leaves the track change guide wall 126 for guidance, so that the cylindrical main steel wheel 38 cooperates with the turning rail flange 132 to guide through the divergence point tread 134 and travel to the position 129. At position 129, the cooperation and guidance of the main steel wheel 38 and the rail flange is switched back to the cooperation and guidance of the central auxiliary rail 7 and the horizontal guide wheel pair 8, and the turnout is completed.

[0116] When the train vehicle reaches 128 from right to left and merges straight, the cooperation and guidance of the central auxiliary rail 7 and the horizontal guide wheel pair 8 is released, and the horizontal guide wheel pair 8 is opened. The track change guide wheel 125 retracts and leaves the track change guide wall 123 without guidance, and at the same time, the track change guide wheel 126 extends to contact the track change guide wall 126 for guidance, so that the cylindrical main steel wheel 38 and the straight track flange 131 cooperate to guide through the divergence point tread 134 and travel to position 127. At position 127, the cooperation and guidance of the main steel wheel 38 and the rail flange is switched back to the cooperation and guidance of the central auxiliary rail 7 and the horizontal guide wheel pair 8, and the turnout is completed. When the train vehicle reaches 129 from right to left and merges into the curve, the track change guide wheel 125 extends to contact the track change guide wall 123 for guidance, and the track change guide wheel 126 retracts to leave the track change guide wall 126 without guidance, so that the cylindrical main steel wheel 38 and the turning rail flange 132 cooperate to guide smoothly through the divergence point tread 134 and travel to the position 129. At the position 129, the cooperation guidance of the main steel wheel 38 and the rail flange is switched back to the cooperation guidance of the central auxiliary rail 7 and the horizontal guide wheel pair 8 to complete the passage through the turnout.

[0117] The rail 76 with rail flange in FIG. 45, 46 and 47 can be replaced with a rail 36 and a guide rail without rail flange, as shown in FIG. 20. 72 and 74 are outer guide rails, and 73 and 75 are inner guide rails.

[0118] In summary, the main rail can be a traditional I-shaped rail, a rail with a rail flange, a main rail with an outer guide rail, or a main rail with an inner guide rail. The auxiliary rail can be an auxiliary rail, a linear motor rail, or a track change guide rail. The main steel wheel can be a traditional conical tread with a flange steel wheel, a cylindrical tread with a flange steel wheel, a cylindrical tread without a flange steel wheel, a conical tread without a flange steel wheel plus a main rail horizontal guide wheel, a cylindrical tread without a flange steel wheel plus a main rail horizontal guide wheel, which can be a driving wheel, a brake wheel, or a driven wheel. The auxiliary rails are matched with horizontal guide wheels, horizontal auxiliary wheels, horizontal drive auxiliary wheels, horizontal brake auxiliary wheels, contact auxiliary rail brake pads, derailment prevention horizontal claws, non-contact linear eddy current brake components, and horizontal track change guide wheels.

[0119] The auxiliary rail mentioned above can also be replaced with two, which are laid on the inner or outer side of the main rail, and have horizontal driving auxiliary wheels, horizontal braking auxiliary wheels, horizontal guide wheels, auxiliary rail brake pads, linear eddy current brake components, and derailment prevention horizontal claws.

[0120] The train vehicle described in the present invention is suitable for fuel locomotives, electric locomotives, or trailers. The power source of the electric locomotive has an on-board rechargeable battery, a hydrogen fuel cell, or an external wire power supply. When the external wire is powered, the vehicle's power-taking sheet, power-taking brush, or power-taking wheel is connected to the upper cable, the lower or side power-carrying track of the vehicle. The auxiliary rail can also be made into a power-carrying track. The train vehicle described in the present invention can also be located in a vacuum pipe or vacuum tunnel, with less air resistance and faster speed.

[0121] The various schemes of the innovative invention of the present application can improve the motion performance of the rail and steel wheel train to varying degrees, and the most powerful scheme can produce a substantial improvement. In this scheme, the energy saving of the steel rail and steel wheel mode, high speed of more than 350km/h, no impact on the main steel wheel tread when passing through turnouts, diamond intersections, and crossings can be achieved at the same time, and the performance indicators of rapid acceleration, rapid deceleration, rapid uphill, rapid downhill, sharp turn, and no derailment are much better than the existing steel rail and steel wheel mode. The present invention can also enable high-speed trains with a speed of more than 350 km/h, heavy-load freight trains, urban rail transit trains, etc. to share a same railway. This is a major improvement in the rail and steel wheel mode of rail transportation in the past century, which will greatly affect the planning and construction of passenger and freight transportation of national railways, urban railways, and intercity railways,

and will also have a great impact on the traffic competition relationship between trains, cars, and airplanes.

[0122] This embodiment does not impose any formal restrictions on the shape, material, structure, etc. of the present invention. Any simple modification, equivalent change, and modification made to the above embodiments based on the technical essence of the present invention shall fall within the protection scope of the technical solution of the present invention.

[0123] The various device components, modules, units, blocks, or portions may have modular configurations, or are composed of discrete components, but nonetheless can be referred to as "modules" in general. In other words, the "components," "modules," "blocks," "portions," or "units" referred to herein may or may not be in modular forms, and these phrases may be interchangeably used.

[0124] In the present disclosure, the terms "installed," "connected," "coupled," "fixed" and the like shall be understood broadly, and can be either a fixed connection or a detachable connection, or integrated, unless otherwise explicitly defined. These terms can refer to mechanical or electrical connections, or both. Such connections can be direct connections or indirect connections through an intermediate medium. These terms can also refer to the internal connections or the interactions between elements. The specific meanings of the above terms in the present disclosure can be understood by those of ordinary skill in the art on a case-by-case basis.

[0125] In the description of the present disclosure, the terms "one embodiment," "some embodiments," "example," "specific example," or "some examples," and the like can indicate a specific feature described in connection with the embodiment or example, a structure, a material or feature included in at least one embodiment or example. In the present disclosure, the schematic representation of the above terms is not necessarily directed to the same embodiment or example.

[0126] Moreover, the particular features, structures, materials, or characteristics described can be combined in a suitable manner in any one or more embodiments or examples. In addition, various embodiments or examples described in the specification, as well as features of various embodiments or examples, can be combined and reorganized.

[0127] To provide for interaction with a user, implementations of the subject matter described in this specification can be implemented with a computer and/or a display device, e.g., a VR/AR device, a head-mount display (HMD) device, a head-up display (HUD) device, smart eyewear (e.g., glasses), a CRT (cathode-ray tube), LCD (liquid-crystal display), OLED (organic light emitting diode), or any other monitor for displaying information to the user and a keyboard, a pointing device, e.g., a mouse, trackball, etc., or a touch screen, touch pad, etc., by which the user can provide input to the computer.

[0128] While this specification contains many specific implementation details, these should not be construed as limitations on the scope of any claims, but rather as descriptions of features specific to particular implementations. Certain features that are described in this specification in the context of separate implementations can also be implemented in combination in a single implementation. Conversely, various features that are described in the context of a single implementation can also be implemented in multiple implementations separately or in any suitable subcombination.

[0129] Moreover, although features can be described above as acting in certain combinations and even initially claimed as such, one or more features from a claimed combination can in some cases be excised from the combination, and the claimed combination can be directed to a subcombination or variation of a subcombination.

[0130] Similarly, while operations are depicted in the drawings in a particular order, this should not be understood as requiring that such operations be performed in the particular order shown or in sequential order, or that all illustrated operations be performed, to achieve desirable results. In certain circumstances, multitasking and parallel processing can be advantageous. Moreover, the separation of various system components in the implementations described above should not be understood as requiring such separation in all implementations, and it should be understood that the described program components and systems can generally be integrated together in a single software product or packaged into multiple software products.

[0131] As such, particular implementations of the subject matter have been described. Other implementations are within the scope of the following claims. In some cases, the actions recited in the claims can be performed in a different order and still achieve desirable results. In addition, the processes depicted in the accompanying FIG. do not necessarily require the particular order shown, or sequential order, to achieve desirable results. In certain implementations, multitasking or parallel processing can be utilized.

[0132] It is intended that the specification and embodiments be considered as examples only. Other embodiments of the disclosure will be apparent to those skilled in the art in view of the specification and drawings of the present disclosure. That is, although specific embodiments have been described above in detail, the description is merely for purposes of illustration. It should be appreciated, therefore, that many aspects described above are not intended as required or essential elements unless explicitly stated otherwise.

[0133] Various modifications of, and equivalent acts corresponding to, the disclosed aspects of the example embodiments, in addition to those described above, can be made by a person of ordinary skill in the art, having the benefit of the present disclosure, without departing from the spirit and scope of the disclosure defined in the following claims, the scope of which is to be accorded the broadest interpretation so as to encompass such modifications and equivalent structures.

[0134] It should be understood that "a plurality" or "multiple" as referred to herein means two or more. "And/or," describing the association relationship of the associated objects, indicates that there may be three relationships, for example, A and/or B may indicate that there are three cases where A exists separately, A and B exist at the same time, and B exists separately. The character "/" generally indicates that the contextual objects are in an "or" relationship.

[0135] In the present disclosure, it is to be understood that the terms "lower," "upper," "under" or "beneath" or "underneath," "above," "front," "back," "left," "right," "top," "bottom," "inner," "outer," "horizontal," "vertical," and other orientation or positional relationships are based on example orientations illustrated in the drawings, and are merely for the convenience of the description of some embodiments, rather than indicating or implying the device or component being constructed and operated in a particular orientation. Therefore, these terms are not to be construed as limiting the scope of the present disclosure.

[0136] Moreover, the terms "first" and "second" are used for descriptive purposes only and are not to be construed as indicating or implying a relative importance or implicitly indicating the number of technical features indicated. Thus, elements referred to as "first" and "second" may include one or more of the features either explicitly or implicitly. In the description of the present disclosure, "a plurality" indicates two or more unless specifically defined otherwise.

[0137] In the present disclosure, a first element being "on" a second element may indicate direct contact between the first and second elements, without contact, or indirect geometrical relationship through one or more intermediate media or layers, unless otherwise explicitly stated and defined. Similarly, a first element being "under," "underneath" or "beneath" a second element may indicate direct contact between the first and second elements, without contact, or indirect geometrical relationship through one or more intermediate media or layers, unless otherwise explicitly stated and defined.

[0138] Some other embodiments of the present disclosure can be available to those skilled in the art upon consideration of the specification and practice of the various embodiments disclosed herein. The present application is intended to cover any variations, uses, or adaptations of the present disclosure following general principles of the present disclosure and include the common general knowledge or conventional technical means in the art without departing from the present disclosure. The specification and examples can be shown as illustrative only, and the true scope and spirit of the disclosure are indicated by the following claims.

Claims

1. A motion mechanism of steel rail track and steel wheel vehicle comprising one or both of a track and a vehicle, wherein the track comprises two main steel rails, one or two auxiliary rails, and a turnout; and the main steel rail and the auxiliary rail form a ballastless track or a ballast track; the vehicle comprises: a vehicle body, a main steel wheel, and a derailment prevention horizontal claw; the main steel wheel has a rim, the tread is a conical surface, and the left and right main steel wheels and the axle form a rigid wheel pair; the track and the vehicle have the following features:

(1) the distance between the main steel rails is 1435 mm standard gauge, a wide gauge length greater than 1435 mm, or a narrow gauge length less than 1435 mm; the cross-sectional shape of the steel rail is I-shaped; the seam in the length direction of the main steel rail is a weld seam, an inclined seam, or a straight seam;

(2) The auxiliary rail is parallel to the main steel rail, and is one of the two main steel rails, two of the two main steel rails, or two of the outer sides of the two main steel rails; The auxiliary rail has an upper wing with or without a lower wing; the upper wing is higher than the upper surface tread of the main steel rail, and the lower wing and the fixing piece are lower than the tread on the upper surface of the main steel rail; when the auxiliary rail is one, the cross-sectional shape is I-shaped orT-shaped; when the auxiliary rail is two, the shape of the cross section is I-shaped or T-shaped or other shapes; the seam in the length direction of the auxiliary rail is a welding seam, an inclined seam, a sawtooth seam, or a straight seam; the auxiliary rail has or has no stator or rotor of the linear motor;

(3) the main steel wheel is mounted on the bogie below the vehicle body, or is directly mounted on the vehicle body without the bogie, and rolls on the upper surface of the main steel rail to support the weight of the vehicle; the main steel wheel is a driving wheel, a braking wheel, or a driven wheel, or is switched to the state of the driving wheel, the braking wheel, or the driven wheel according to control;

(4) the derailment prevention horizontal claw is mounted on the bogie below the vehicle body, or is directly mounted on the vehicle body without the bogie, and is higher than the tread on the upper surface of the main steel rail, and the horizontal claw is below the auxiliary rail upper wing; when the auxiliary rail is one, a pair of horizontal claws is arranged on the left and right of the waist of the auxiliary rail and holds the upper wing of the auxiliary rail; when the auxiliary rail is two, there is a pair of horizontal claws, or two pairs of horizontal claws, an upper wing of the embracing auxiliary rail, or an upper wing

embracing;
(5) There is a certain gap between the horizontal direction, the horizontal claw end and the auxiliary rail waist, or between the horizontal claw root and the auxiliary rail upper wing end, which is usually not in contact, so that the left and right swinging of the vehicle generated when the main steel wheel conical surface tread and the main steel rail are matched and guided is not affected; but the gap is not very large, and when the vehicle swings left and right or moves to a large possible derailing, the end of the horizontal claw is in contact with the waist of the auxiliary rail, or the root of the horizontal claw is in contact with the end of the upper wing of the auxiliary rail, so that left-right movement is limited to prevent derailment; In addition, there is a certain gap between the upper surface of the horizontal claw and the lower surface of the upper wing of the auxiliary rail, which is usually not in contact; however, the gap is not very large, and when the train jumps up or lifts for some reason, the upper surface of the horizontal claw is in contact with the lower surface of the I-shaped upper wing, preventing upward movement of the train;
(6) In the turnout section, the switch rail section of the main steel rail is driven by the switch machine to swing left and right, and the rim of the main steel wheel is guided in cooperation with the main steel rail to change the rail; the auxiliary rail is not laid in the turnout section, is higher than the derailment prevention horizontal claw on the upper surface of the main steel rail, passes over the main steel rail above, does not collide with the main steel rail, and smoothly resleeves the two sides of the auxiliary rail after passing through the auxiliary rail interruption section; or the auxiliary rail swings left and right in the turnout section, the upper wing crosses over the main steel rail, the derailment prevents the horizontal claw from being always sleeved on the auxiliary rail upper wing, passes over the main steel rail above, does not collide with the main steel rail, and passes through the turnout section;
(7) The main steel wheel of the vehicle can roll and run on a traditional rail without an auxiliary rail, a wide gauge, or a steel rail with a narrow gauge, and can roll through a traditional turnout; the derailment prevents the horizontal claw from colliding with the main steel rail above the main steel rail;
(8) The main steel rail, the traditional gauge without derailment, prevents the standard gauge, the wide gauge, or the narrow gauge of the horizontal claw from being able to roll and run above, and can roll through the switch; for the auxiliary rail higher than the upper surface of the main steel rail, the corresponding components below the traditional train are removed or modified, so that the lower part of the train does not contact the auxiliary rail and can run in the whole process.

2. The motion mechanism of the steel rail track and steel wheel vehicle according to claim 1, **characterized in that** the derailment prevents the fixed end of the horizontal claw from being replaced with a horizontal rolling wheel or a vertical rolling wheel, so that when the horizontal rolling wheel or the vertical rolling wheel is in contact with the vertical surface of the auxiliary rail or the lower surface of the upper wing, the sliding contact is changed into rolling contact, and friction is reduced; the horizontal rolling wheel or the vertical rolling wheel is mounted on the rigid or elastic support body, and usually does not contact the vertical surface of the auxiliary rail or the lower surface of the upper wing; or the horizontal rolling wheel or the vertical rolling wheel is mounted on the elastic supporting body and usually rolls to contact the vertical surface of the auxiliary rail or the lower surface of the upper wing to define a large left-right movement or an upward movement.

3. The motion mechanism of the steel rail track and steel wheel vehicle according to claim 1, wherein the auxiliary rail is a power supply rail for supplying power to the vehicle from the rail.

4. A motion mechanism of steel rail track and steel wheel vehicle comprising one or both of a track and a vehicle, wherein the track comprises two main steel rails, one or two auxiliary rails, and a turnout; and the main steel rail and the auxiliary rail form a ballastless track or a ballastless track; The vehicle comprises: a vehicle body, a main steel wheel, and an auxiliary rail acting assembly; the main steel wheel has a rim, the tread is a conical surface, and the left and right main steel wheels and the axle form a rigid wheel pair; the auxiliary rail action assembly is one or more of: 1) a horizontal auxiliary wheel; 2) an auxiliary rail brake block; 3) an auxiliary rail brake block plus buffer wheel; 4) a linear eddy current brake assembly; 5) a rotor or stator of the vehicle linear motor; and the rail and the vehicle have the following features:

(1) the distance between the main steel rails is 1435 mm standard gauge, a wide gauge length greater than 1435 mm, or a narrow gauge length less than 1435 mm; the cross-sectional shape of the steel rail is I-shaped; the seam in the length direction of the main steel rail is a weld seam, an inclined seam, or a straight seam;
(2) The auxiliary rail is parallel to the main steel rail, and is one of the two main steel rails, two of

the two main steel rails, or two of the outer sides of the two main steel rails; the cross-sectional shape of the auxiliary rail is I-shaped or T-shaped, and has an upper wing and a waist, the left and right vertical planes of the waist are auxiliary rail tread, and the auxiliary rail has or has no lower wing; the upper wing is higher than the upper surface tread of the main steel rail, and the lower wing and the fixing piece are lower than the tread on the upper surface of the main steel rail; the tread material of the auxiliary rail is an iron alloy or a wear-resistant material of the artificial stone; the seam in the length direction of the auxiliary rail is a welding seam, an inclined seam, a sawtooth seam or a straight seam;

(3) the main steel wheel is mounted on the bogie below the vehicle body, or is directly mounted on the vehicle body without the bogie, and rolls on the upper surface of the main steel rail to support the weight of the vehicle; the main steel wheel is a driving wheel, a braking wheel, or a driven wheel, or is switched to the state of the driving wheel, the braking wheel, or the driven wheel according to control; the rim and the conical surface tread of the main steel wheel are guided in cooperation with the main steel rail;

(4) The auxiliary rail action assembly is mounted on the bogie below the vehicle body, or is directly mounted on the vehicle body when there is no bogie, and is higher than the main steel rail tread; the horizontal auxiliary wheel, the auxiliary rail brake block and the auxiliary rail brake block plus buffer wheel are auxiliary rail contact assemblies; the left auxiliary rail contact assembly and the right auxiliary rail contact assembly become a pair and become an auxiliary rail contact assembly pair, and are driven by an air pressure piston, a hydraulic piston, an electromagnetic piston, or a magnetic attraction, and are extruded on the auxiliary rail tread from left to right without supporting the weight of the vehicle; the horizontal auxiliary wheel is a driving wheel, a brake wheel, or a driven wheel, or is switched to a state of a driving wheel, a brake wheel, or a driven wheel according to control; the horizontal auxiliary wheel is a friction surface rolling rather than a gear rolling, It is also not a rubber tire; and the tread material of the horizontal auxiliary wheel, the horizontal auxiliary brake block or the horizontal buffer wheel is a metal alloy or a wear-resistant material of the artificial stone; and the tread width of the auxiliary rail contact assembly is greater than 20 mm; the linear eddy current braking assembly is an auxiliary rail non-contact assembly mounted above the auxiliary rail to perform non-contact braking with the auxiliary rail upper wing, or the left and right linear eddy current braking assemblies become a pair, and act on the auxiliary rail tread from left to right to perform non-contact braking; when the auxiliary rail has a stator or a rotor of a linear motor, the vehicle is mounted with a rotor or a stator of a matched linear motor higher than the main steel rail tread;

(5) The horizontal auxiliary wheel has less motive force for driving or braking, and the squeezing force of the horizontal auxiliary wheel pair is also small; when the motive force of the horizontal auxiliary wheel set for driving or braking is large, the extrusion force of the horizontal auxiliary wheel pair is also large, so as to avoid excessive extrusion force when the motive force is relatively small, and generate large frictional resistance; also avoid the situation that the extrusion force is too small when the motive force is large, and the horizontal auxiliary wheel slips when rolling on the auxiliary rail tread; the auxiliary rail brake block pair and the auxiliary rail are sliding friction braking, and the magnitude of the braking force is directly related to the extrusion force;

(6) The auxiliary rail action assembly is not guided in the case of normal operation; and the auxiliary rail contact assembly pair freely moves left and right relative to the main steel wheel of the vehicle when the auxiliary rail is extruded from left to right so as not to affect the cooperative guidance of the conical surface tread of the main steel wheel and the main steel rail; but the left-right free movement amount is not very large, and when the train swings left and right or moves greatly, it is possible to move left and right to limit the left-right movement, thereby preventing left-right derailment; the overall left and right motion mechanism is: 1) the auxiliary rail contact assembly is integrally mounted on a guide rail capable of freely sliding left and right; 2) the auxiliary rail contact assembly is integrally mounted on a rotating shaft or a circular hole capable of freely rotating left and right; 3) the auxiliary rail contact assembly pair is simultaneously provided by the same air pressure pipeline, the piston of the same hydraulic pipeline or motor, or magnetic attraction, Drive the auxiliary rails from left and right; the air pressure pipeline, the hydraulic pipeline or the motor, or the magnetic attraction, only controls the extrusion force or loosening of the auxiliary rail contact assembly pair, and at the same time, enables the auxiliary rail contact assembly to freely move in the left-right direction; In addition, there is a certain gap between the upper surface of the auxiliary rail contact assembly and the lower surface of the auxiliary rail upper wing in the vertical direction, and usually does not make contact; but the gap is not very large, and when

the train jumps up or lifts for some reason, the upper surface of the auxiliary rail contact assembly is in contact with the lower surface of the I-shaped upper wing to prevent upward derailment of the train; the linear eddy current braking assembly and the rotor or stator of the vehicle linear motor have or do not have the overall left-right free movement, and do not affect the cooperative guidance of the conical surface tread of the main steel wheel and the main steel rail;
(7) In the turnout section, the switch rail section of the main steel rail is driven by the switch machine to swing left and right, and the rim of the main steel wheel is guided in cooperation with the main steel rail to change the rail; the auxiliary rail is not laid in the turnout section, is higher than the auxiliary rail contact assembly pair on the upper surface of the main steel rail, crosses the main steel rail above, does not collide with the main steel rail, and is not extruded when passing through the auxiliary rail interruption section, or has a horn mouth shape, so that after passing through the auxiliary rail interruption section, the auxiliary rail is smoothly sleeved on the two sides of the auxiliary rail again; or the auxiliary rail swings left and right in the turnout section, the auxiliary rail tread passes over the upper portion of the main steel rail, the auxiliary rail contact assembly pair always sleeves the two sides of the auxiliary rail tread, passes over the main steel rail above, does not collide with the main steel rail, and passes through the turnout section; the linear eddy current braking assembly and the rotor or stator of the vehicle linear motor, crossing the main steel rail above, without colliding with the main steel rail, and passing through the turnout section;
(8) Driving or Braking of the Vehicle, Including Driving or Braking of the Main Rail or/and Driving or Braking of the Auxiliary Rail; wherein the driving or braking of the auxiliary rail comprises one or more of the following: 1) driving or braking of the horizontal auxiliary wheel of the auxiliary rail, 2) braking of the auxiliary rail braking block, 3) braking of the linear eddy current braking assembly of the auxiliary rail, and 4) driving or braking of the linear motor of the auxiliary rail; the driving or braking of the main steel rail and the auxiliary rail adopts or does not adopt the following distribution: 1) when the driving force or braking force required by the vehicle is small, or the driving or braking of the main steel rail and the main steel wheel is sufficient, only the driving or braking of the main steel rail and the main steel wheel is used; 2) when the driving force or braking force required by the vehicle is large or the driving or braking of the main steel rail and the main steel wheel is not enough, the vehicle uses the driving or braking of the main steel rail and the auxiliary rail at the same time, or only uses the driving or braking of the auxiliary rail;
(9) the vehicle and the main steel wheel of the vehicle can roll and run on a traditional rail without an auxiliary rail, a wide gauge, or a narrow gauge rail, and can roll through a traditional turnout; the auxiliary rail acting assembly is above the main steel rail and does not collide with the main steel rail;
(10) The steel wheels of the main steel rail, the traditional gauge without the auxiliary rail acting assembly, the wide gauge, or the narrow gauge train can roll and run above, and can roll through the switch; and for the auxiliary rail higher than the upper surface of the main steel rail, the corresponding components below the traditional train are removed or modified, so that the lower portion of the train does not contact the auxiliary rail and can run in the whole process.

5. A motion mechanism of steel rail track and steel wheel vehicle comprising one or both of a track and a vehicle, wherein the track comprises two main steel rails, one or two auxiliary rails, and a turnout; and the main steel rail and the auxiliary rail form a ballastless track or a ballastless track; The vehicle comprises: a vehicle body, a main steel wheel, an auxiliary rail guide wheel, and an auxiliary rail acting assembly; The main steel wheel is provided with a wheel rim, the tread is a cylindrical surface, and the left and right main steel wheels are independent rolling wheel pairs and are not rigid wheel pairs; the auxiliary rail acting assembly is one or more of the following: 1) a horizontal auxiliary wheel; 2) an auxiliary rail brake block; 3) an auxiliary rail brake block plus buffer wheel; 4) a linear eddy current brake assembly; 5) a rotor or stator of a vehicle linear motor; and the rail and the vehicle have the following features:

(1) the distance between the main steel rails is 1435 mm standard gauge, a wide gauge length greater than 1435 mm, or a narrow gauge length less than 1435 mm; the seam in the length direction of the main steel rail is a weld seam, an inclined seam, a sawtooth seam, or a straight seam;
(2) The auxiliary rail is parallel to the main steel rail, and is one of the two main steel rails, two of the two main steel rails, or two of the outer sides of the two main steel rails; the cross-sectional shape of the auxiliary rail is I-shaped or T-shaped, and has an upper wing and a waist, the left and right vertical planes of the waist are auxiliary rail tread, and the auxiliary rail has or

has no lower wing; the upper wing is higher than the upper surface tread of the main steel rail, and the lower wing and the fixing piece are lower than the tread on the upper surface of the main steel rail; the tread material of the auxiliary rail is an iron alloy or a wear-resistant material of the artificial stone; the seam in the length direction of the auxiliary rail is a welding seam, an inclined seam, a sawtooth seam or a straight seam;

(3) the main steel wheel is mounted on the bogie below the vehicle body, or is directly mounted on the vehicle body without the bogie, and rolls on the upper surface of the main steel rail to support the weight of the vehicle; the main steel wheel is a driving wheel, a braking wheel, or a driven wheel, or is switched to the state of the driving wheel, the braking wheel, or the driven wheel according to the control; during normal operation of the straight line and the curve segment outside the turnout, the rhombic intersection and the crossing, the rim of the main steel wheel is not guided;

(4) an auxiliary rail guide wheel, wherein the auxiliary rail action assembly is mounted on a bogie below the vehicle body, or is directly mounted on the vehicle body when there is no bogie, and is higher than the main steel rail tread; the left auxiliary rail guide wheel and the right auxiliary rail guide wheel form a pair to form an auxiliary rail guide wheel pair, and the auxiliary rail guide wheel pair is guided on two sides of the auxiliary rail tread; the horizontal auxiliary wheel, the auxiliary rail brake block and the auxiliary rail brake block plus buffer wheel are auxiliary rail contact assemblies; the left auxiliary rail contact assembly and the right auxiliary rail contact assembly form a pair to form an auxiliary rail contact assembly pair; the auxiliary rail contact assembly pair is driven by an air pressure piston, a hydraulic piston, an electromagnetic piston, or a magnetic attraction, and is squeezed from left to right on the auxiliary rail tread without supporting the weight of the vehicle; the extrusion force of the auxiliary rail contact assembly pair is small and loosened, and the train can be controlled and adjusted during operation; the horizontal auxiliary wheel is a driving wheel, The brake wheel, or the driven wheel, or the state of the driven wheel, the brake wheel, or the driven wheel is switched according to control; the auxiliary rail guide wheel and the horizontal auxiliary wheel are friction surfaces rolling instead of gear rolling or rubber tires; and the tread material of the auxiliary rail guide wheel, the horizontal auxiliary wheel, the horizontal auxiliary brake block or the horizontal buffer wheel is a metal alloy or a wear-resistant material of the artificial stone; and the tread width of the auxiliary rail guide wheel and the auxiliary rail contact assembly is greater than 20 mm; the linear eddy current braking assembly is an auxiliary rail non-contact assembly mounted above the auxiliary rail to perform non-contact braking with the auxiliary rail upper wing, or the left and right linear eddy current braking assemblies become a pair, and act on the auxiliary rail tread from left to right to perform non-contact braking; and when the auxiliary rail has a stator or a rotor of a linear motor, installing a rotor or stator of a matched linear motor higher than the tread of the main steel rail on the vehicle;

(5) The horizontal auxiliary wheel has less motive force for driving or braking, and the squeezing force of the horizontal auxiliary wheel pair is also small; when the motive force of the horizontal auxiliary wheel set for driving or braking is large, the extrusion force of the horizontal auxiliary wheel pair is also large, so as to avoid excessive extrusion force when the motive force is relatively small, and generate large frictional resistance; also avoid the situation that the extrusion force is too small when the motive force is large, and the horizontal auxiliary wheel slips when rolling on the auxiliary rail tread; the auxiliary rail brake block pair and the auxiliary rail are sliding friction braking, and the magnitude of the braking force is directly related to the extrusion force;

(6) The auxiliary rail guide wheel pair is guided in the case of normal operation; the auxiliary rail guide wheel pair or the auxiliary rail contact assembly pair does not move left and right as a whole relative to the main steel wheel of the vehicle when guiding or extruding the auxiliary rail left and right, or has a small left-right movement amount, so as to absorb the laying straightness tolerance of the auxiliary rail, avoid interfering with the inertial linear movement of the train in the guiding or extrusion fit of the straight line segment, and make the movement of the train more stable; The overall left and right motion mechanism is as follows: 1) the auxiliary rail guide wheel pair or the auxiliary rail contact assembly is integrally mounted on a guide rail capable of freely sliding left and right; 2) the auxiliary rail guide wheel pair or the auxiliary rail contact assembly is integrally mounted on a rotating shaft or a circular hole which can freely rotate left and right; 3) the auxiliary rail guide wheel pair or the auxiliary rail contact assembly pair, The piston, or magnetic attraction, of the same hydraulic line or motor drives the auxiliary rail from left and right; the air pressure pipeline, the hydraulic pipeline or the motor, or the magnetic attraction, only controls the extrusion force or loosening of the auxiliary rail guide wheel pair

or the auxiliary rail contact assembly pair, and enables the auxiliary rail guide wheel pair or the auxiliary rail contact assembly to freely move in the left-right direction; or, the auxiliary rail guide wheel is fixed on the spring or the spring plate, and has a small left-right movement as a whole, so as to reduce the inertial linear movement of the guide fit in the linear section to interfere with the train; the linear eddy current braking assembly has or does not have the overall left-right free movement, and does not affect the cooperative guidance of the auxiliary rail guide wheel and the auxiliary rail; in addition, there is a certain gap between the upper surface of the auxiliary rail guide wheel or the auxiliary rail contact assembly and the lower surface of the auxiliary rail upper wing, and usually does not contact; however, the gap is not very large, and when the train jumps up or lifts for some reason, the upper surface of the auxiliary rail guide wheel or the auxiliary rail contact assembly is in contact with the lower surface of the upper wing to prevent upward derailment of the train;

(7) In the turnout section, the switch rail section of the main steel rail is driven by the switch machine to swing left and right, and the rim of the main steel wheel is guided in cooperation with the main steel rail to change the rail; the auxiliary rail is not laid in the turnout section, is higher than the auxiliary rail guide wheel set and the auxiliary rail contact assembly pair on the upper surface of the main steel rail, passes over the main steel rail above, does not collide with the main steel rail, and is not extruded when passing through the auxiliary rail interruption section, or has a horn mouth shape, so that after passing through the auxiliary rail interruption section, the auxiliary rail is smoothly sleeved on the two sides of the auxiliary rail again; or the auxiliary rail swings left and right in the turnout section, the auxiliary rail tread passes over the upper portion of the main steel rail, the auxiliary rail guide wheel pair and the auxiliary rail contact assembly pair are always sleeved on two sides of the auxiliary rail tread, over the main steel rail above, the main steel rail is not collided, the auxiliary rail guide wheel is not guided;

(8) Driving or Braking of the Vehicle, Including Driving or Braking of the Main Rail or/and Driving or Braking of the Auxiliary Rail; wherein the driving or braking of the auxiliary rail comprises one or more of the following: 1) driving or braking of the horizontal auxiliary wheel of the auxiliary rail, 2) braking of the auxiliary rail braking block, 3) braking of the linear eddy current braking assembly of the auxiliary rail, and 4) driving or braking of the linear motor of the auxiliary rail; the driving or braking of the main steel rail and the auxiliary rail adopts or does not adopt the following distribution: 1) when the driving force or braking force required by the vehicle is small, or the driving or braking of the main steel rail and the main steel wheel is sufficient, only the driving or braking of the main steel rail and the main steel wheel is used; 2) when the driving force or braking force required by the vehicle is large or the driving or braking of the main steel rail and the main steel wheel is not enough, the vehicle uses the driving or braking of the main steel rail and the auxiliary rail at the same time, or only uses the driving or braking of the auxiliary rail;

(9) the vehicle and the main steel wheel of the vehicle can roll and run on a traditional rail without an auxiliary rail, a wide gauge, or a narrow gauge rail, and can roll through a traditional turnout; the auxiliary rail guide wheel and the auxiliary rail acting assembly are located above the main steel rail, and do not collide with the main steel rail;

(10) The steel wheels of the main steel rail, the traditional gauge without the auxiliary rail acting assembly, the wide gauge, or the narrow gauge train can roll and run above, and can roll through the switch; for the auxiliary rail higher than the upper surface of the main steel rail, the corresponding components below the traditional train are removed or modified, so that the lower portion of the train does not contact the auxiliary rail and can run in the whole process;

(11) The auxiliary rail guide wheel and the horizontal auxiliary wheel are two different wheels or two functional states of the same wheel.

6. The motion mechanism of the steel rail track and steel wheel vehicle according to claim 4 or 5, **characterized in that** the main steel rail has no movable part and the auxiliary rail is not laid in the rhombus crossing or crossing interval; the auxiliary rail guide wheel pair or the auxiliary rail contact assembly pair is not extruded when passing through the auxiliary rail interruption section, or has a horn mouth shape, so that after passing through the auxiliary rail interruption section, the auxiliary rail guide wheel pair or the auxiliary rail contact assembly smoothly resleeves the two sides of the auxiliary rail; and the conical surface tread or rim of the main steel wheel cooperates with the main steel rail to guide, so that the auxiliary rail guide wheel pair or the auxiliary rail contact assembly pair smoothly passes through the rhombic intersection or the crossing section.

7. The motion mechanism of the steel rail track and steel wheel vehicle according to claim 4 or 5, **characterized in that** the vertical rolling wheel is mounted on a bogie below the vehicle body, or is directly mounted on the vehicle body when there is

no bogie, and is located below the auxiliary rail upper wing and higher than the main steel rail tread; the vertical rolling wheel is mounted on the rigid or elastic support body, and usually does not contact the lower surface of the upper wing of the auxiliary rail; when the vehicle is lifted upwards to be large, rolling contact is performed to define a large upward movement; or, the vertical rolling wheel is mounted on the elastic support body, usually rolling and contacting the lower surface of the upper wing of the auxiliary rail, and defining a large left-right movement or upward movement.

8. A motion mechanism of steel rail track and steel wheel vehicle comprising one or both of a track and a vehicle, wherein the track comprises two main steel rails, one or two auxiliary rails, and a turnout; and the main steel rail and the auxiliary rail form a ballastless track or a ballastless track; The vehicle comprises: a vehicle body, a main steel wheel, an auxiliary rail guide wheel, and an auxiliary rail acting assembly; The auxiliary rail action assembly is one or more of the following: 1) a horizontal auxiliary wheel; 2) an auxiliary rail brake block; 3) an auxiliary rail brake block plus buffer wheel; 4) a linear eddy current brake assembly; 5) a rotor or stator of a vehicle linear motor; and the rail and the vehicle have the following features:

(1) the distance between the main steel rails is 1435 mm standard gauge, a wide gauge length greater than 1435 mm, or a narrow gauge length less than 1435 mm; the seam in the length direction of the main steel rail is a weld seam, an inclined seam, a sawtooth seam, or a straight seam;

(2) The auxiliary rail is parallel to the main steel rail, and is one of the two main steel rails, two of the two main steel rails, or two of the outer sides of the two main steel rails; the cross-sectional shape of the auxiliary rail is I-shaped or T-shaped, and has an upper wing and a waist, the left and right vertical planes of the waist are auxiliary rail tread, and the auxiliary rail has or has no lower wing; the upper wing is higher than the upper surface tread of the main steel rail, and the lower wing and the fixing piece are lower than the tread on the upper surface of the main steel rail; the tread material of the auxiliary rail is an iron alloy or a wear-resistant material of the artificial stone; the seam in the length direction of the auxiliary rail is a welding seam, an inclined seam, a sawtooth seam or a straight seam;

(3) the main steel wheel is mounted on a bogie below the vehicle body, or is directly mounted on the vehicle body without a bogie, and rolls on the upper surface of the main steel rail to support the weight of the vehicle; the main steel wheel is a driving wheel, a braking wheel, or a driven wheel, or is switched to a state of a driving wheel, a braking wheel, or a driven wheel according to control;

(4) an auxiliary rail guide wheel, wherein the auxiliary rail action assembly is mounted on a bogie below the vehicle body, or is directly mounted on the vehicle body when there is no bogie, and is higher than the main steel rail tread; the left auxiliary rail guide wheel and the right auxiliary rail guide wheel form a pair to form an auxiliary rail guide wheel pair, and the auxiliary rail guide wheel pair is guided on two sides of the auxiliary rail tread; the horizontal auxiliary wheel, the auxiliary rail brake block and the auxiliary rail brake block plus buffer wheel are auxiliary rail contact assemblies; the left auxiliary rail contact assembly and the right auxiliary rail contact assembly form a pair to form an auxiliary rail contact assembly pair; the auxiliary rail contact assembly pair is driven by an air pressure piston, a hydraulic piston, an electromagnetic piston, or a magnetic attraction, and is squeezed from left to right on the auxiliary rail tread without supporting the weight of the vehicle; the extrusion force of the auxiliary rail contact assembly pair is small and loosened, and the train can be controlled and adjusted during operation; the horizontal auxiliary wheel is a driving wheel, The brake wheel, or the driven wheel, or the state of the driven wheel, the brake wheel, or the driven wheel is switched according to control; the auxiliary rail guide wheel and the horizontal auxiliary wheel are friction surfaces rolling instead of gear rolling or rubber tires; and the tread material of the auxiliary rail guide wheel, the horizontal auxiliary wheel, the horizontal auxiliary brake block or the horizontal buffer wheel is a metal alloy or a wear-resistant material of the artificial stone; and the tread width of the auxiliary rail guide wheel and the auxiliary rail contact assembly is greater than 20 mm; the linear eddy current braking assembly is an auxiliary rail non-contact assembly mounted above the auxiliary rail to perform non-contact braking with the auxiliary rail upper wing, or the left and right linear eddy current braking assemblies become a pair, and act on the auxiliary rail tread from left to right to perform non-contact braking; and when the auxiliary rail has a stator or a rotor of a linear motor, installing a rotor or stator of a matched linear motor higher than the tread of the main steel rail on the vehicle;

(5) The horizontal auxiliary wheel has less motive force for driving or braking, and the squeezing force of the horizontal auxiliary wheel pair is also small; when the motive force of the horizontal auxiliary wheel set for driving or braking is

large, the extrusion force of the horizontal auxiliary wheel pair is also large, so as to avoid excessive extrusion force when the motive force is relatively small, and generate large frictional resistance; also avoid the situation that the extrusion force is too small when the motive force is large, and the horizontal auxiliarywheel slips when rolling on the auxiliary rail tread; the auxiliary rail brake block pair and the auxiliary rail are sliding friction braking, and the magnitude of the braking force is directly related to the extrusion force;

(6) The auxiliary rail guide wheel pair is guided in the case of normal operation; the auxiliary rail guide wheel pair or the auxiliary rail contact assembly pair does not move left and right as a whole relative to the main steel wheel of the vehicle when guiding or extruding the auxiliary rail left and right, or has a small left-right movement amount, so as to absorb the laying straightness tolerance of the auxiliary rail, avoid interfering with the inertial linear movement of the train in the guiding or extrusion fit of the straight line segment, and make the movement of the train more stable; The overall left and right motion mechanism is as follows: 1) the auxiliary rail guide wheel pair or the auxiliary rail contact assembly is integrally mounted on a guide rail capable of freely sliding left and right; 2) the auxiliary rail guide wheel pair or the auxiliary rail contact assembly is integrally mounted on a rotating shaft or a circular hole which can freely rotate left and right; 3) the auxiliary rail guide wheel pair or the auxiliary rail contact assembly pair, The piston, or magnetic attraction, of the same hydraulic line or motor drives the auxiliary rail from left and right; the air pressure pipeline, the hydraulic pipeline or the motor, or the magnetic attraction, only controls the extrusion force or loosening of the auxiliary rail guide wheel pair or the auxiliary rail contact assembly pair, and enables the auxiliary rail guide wheel pair or the auxiliary rail contact assembly to freely move in the left-right direction; or, the auxiliary rail guide wheel is fixed on the spring or the spring plate, and has a small left-right movement as a whole, so as to reduce the inertial linear movement of the guide fit in the linear section to interfere with the train; the linear eddy current braking assembly has or does not have the overall left-right free movement, and does not affect the cooperative guidance of the auxiliary rail guide wheel and the auxiliary rail; in addition, there is a certain gap between the upper surface of the auxiliary rail guide wheel or the auxiliary rail contact assembly and the lower surface of the auxiliary rail upper wing, and usually does not contact; however, the gap is not very large, and when the train jumps up or lifts for some reason, the upper surface of the auxiliary rail guide wheel or the auxiliary rail contact assembly is in contact with the lower surface of the upper wing to prevent upward derailment of the train;

(7) In the turnout section, the main steel rail has a non-movable branch point and a frog center, there is no movable part, there is no movable switch rail, there is no movable frog center, and the upper tread of the main steel rail is not larger than 10 mm;

(8) Driving or Braking of the Vehicle, Including Driving or Braking of the Main Rail or/and Driving or Braking of the Auxiliary Rail; wherein the driving or braking of the auxiliary rail comprises one or more of the following: 1) driving or braking of the horizontal auxiliary wheel of the auxiliary rail, 2) braking of the auxiliary rail braking block, 3) braking of the linear eddy current braking assembly of the auxiliary rail, and 4) driving or braking of the linear motor of the auxiliary rail; the driving or braking of the main steel rail and the auxiliary rail adopts or does not adopt the following distribution: 1) when the driving force or braking force required by the vehicle is small, or the driving or braking of the main steel rail and the main steel wheel is sufficient, only the driving or braking of the main steel rail and the main steel wheel is used; 2) when the driving force or braking force required by the vehicle is large or the driving or braking of the main steel rail and the main steel wheel is not enough, the vehicle uses the driving or braking of the main steel rail and the auxiliary rail at the same time, or only uses the driving or braking of the auxiliary rail;

(9) a cylindrical tread main steel wheel without a rim of the vehicle, if the guide steel wheel with the inner wheel rim rolls on the upper surface of the main steel rail for guiding, or increasing the rolling of the horizontal guide wheel on the inner side surface of the main steel rail to guide, the horizontal guide wheel can roll and run on a traditional steel rail without a standard gauge, a wide gauge, or a narrow gauge of the auxiliary rail, and can roll through a traditional turnout;

(10) The auxiliary rail guide wheel and the horizontal auxiliary wheel are two different wheels or two functional states of the same wheel.

9. The motion mechanism of the steel rail track and steel wheel vehicle according to claim 8, **characterized in that**: the turnout section and the rail have a left-right swing switching mechanism, and the mechanism has one or more of the following orbital transfer structures: 1) the auxiliary rail has a movable section to guide and change the rail; the movable section of the auxiliary rail is driven by the switch machine to swing left and right; the tread portion of

the movable end of the auxiliary rail is provided with an extending arm, a main steel rail swings from the upper portion of the main steel rail, and the tread portion of the fixed end of the auxiliary rail is connected with the tread portion of the fixed end of the auxiliary rail through an inclined seam or a sawtooth seam, so that the auxiliary rail guide wheel pair or the auxiliary rail acting assembly of the vehicle does not roll over or pass through a gap of the auxiliary rail guide tread, and the guide rail is guided; 2) the two movable auxiliary rails are higher than the upper surface of the main steel rail and are driven by the switch machine, The vehicle is guided to change the rail by swinging left and right across the main steel rail; and the movable end of the auxiliary rail is connected with the fixed end of the auxiliary rail through an inclined seam or a sawtooth seam, so that the auxiliary rail guide wheel pair or the auxiliary rail acting assembly of the vehicle does not roll over or pass through a gap of the auxiliary rail guide tread, and the guide rail is guided; 3) In the turnout section, the auxiliary rail is not laid in the orbital transfer section; the auxiliary rail guide wheel pair and the auxiliary rail contact assembly pair are not extruded when passing through the auxiliary rail interruption section, so that after passing through the auxiliary rail interruption section, the auxiliary rail guide wheel pair and the auxiliary rail contact assembly are smoothly sleeved on the two sides of the auxiliary rail again; a horizontal rail change guide wheel is installed on the outer side of the left main steel rail and the right main steel rail of the vehicle; 4) In the turnout interval, the switch machine drives the movable section of the left and right swing auxiliary rails; and the tread portion of the movable end of the auxiliary rail does not cross the main steel rail from above the main steel rail, but is not laid in the middle of the main steel rail; the auxiliary rail guide wheel pair and the auxiliary rail contact assembly pair are not extruded when passing through the auxiliary rail interruption section, so that after passing through the auxiliary rail interruption section, the auxiliary rail guide wheel pair and the auxiliary rail contact assembly are smoothly sleeved on the two sides of the auxiliary rail again; at this time, the horizontal rail change guide wheel of the train is matched and guided with the fixed rail transfer guide rail, so that the auxiliary rail guide wheel pair and the auxiliary rail contact assembly pair smoothly pass through the auxiliary rail interruption section; 5) in the turnout interval, part of the main steel rail is replaced with the steel rail with the outer rail edge and the inner rail edge, and the switch machine drives the movable section of the left and right swing auxiliary rail; the tread portion of the movable end of the auxiliary rail, Rather than passing over the main rail from above the main rail, the interruption is not laid; the auxiliary rail guide wheel pair and the auxiliary rail contact assembly pair are not extruded when passing through the auxiliary rail interruption section, so that after passing through the auxiliary rail interruption section, the auxiliary rail guide wheel pair and the auxiliary rail contact assembly are smoothly sleeved on the two sides of the auxiliary rail again; at this time, the train main steel wheel is guided by the outer rail edge and the inner rail edge of one steel rail, so that the auxiliary rail guide wheel pair and the auxiliary rail contact assembly pair smoothly pass through the auxiliary rail interruption section; 6) in the turnout interval, part of the main steel rail is replaced with a steel rail with an outer rail edge, and the switch machine drives the movable section of the left-right swing auxiliary rail; the tread portion of the movable end of the auxiliary rail does not cross the main steel rail from above the main steel rail but is not laid in the middle; the auxiliary rail guide wheel pair and the auxiliary rail contact assembly pair are not extruded when passing through the auxiliary rail interruption section, After passing through the auxiliary rail interruption section, the auxiliary rail is smoothly re-sleeved on both sides of the auxiliary rail; at this time, the train main steel wheel is guided by the outer rail edges of the two steel rails, so that the auxiliary rail guide wheel pair and the auxiliary rail contact assembly pair smoothly pass through the auxiliary rail interruption section; 7) in the turnout interval, an outer guide rail and an inner guide rail are additionally arranged on two sides of a part of the main steel rail section, and the switch machine drives the movable section of the left-right swing auxiliary rail; the tread portion of the movable end of the auxiliary rail does not cross the main steel rail from above the main steel rail, but is not laid; the auxiliary rail guide wheel pair and the auxiliary rail contact assembly pair are not extruded when passing through the auxiliary rail interruption section, so that after passing through the auxiliary rail interruption section, the auxiliary rail is smoothly re-sleeved on both sides of the auxiliary rail; at this time, The main steel wheel of the train is guided by the outer guide rail and the inner guide rail on both sides of one main steel rail, so that the auxiliary rail guide wheel pair and the auxiliary rail contact assembly pair smoothly pass through the auxiliary rail interruption section; 8) in the turnout interval, part of the main steel rail section increases the outer guide rail, and the switch machine drives the movable section of the left-right swing auxiliary rail; the auxiliary rail guide wheel pair and the auxiliary rail contact assembly pair are not extruded when passing through the auxiliary rail interruption section, so that after passing through the auxiliary rail interruption section, the auxiliary rail guide wheel pair and the auxiliary rail contact assembly are smoothly re-sleeved on both sides of the auxiliary rail; at this time, the train main steel wheel is guided by the outer guide rails of the two steel rails, so that

the auxiliary rail guide wheel pair and the auxiliary rail contact assembly pair, Smoothly passing through the auxiliary rail interruption section.

10. The motion mechanism of the steel rail track and steel wheel vehicle according to claim 8, **characterized in that**: the rail has no left-right swing switching mechanism, a movable rail-changeable guide wheel is arranged on the train vehicle, and a turning operation is performed to realize orbital transfer, and the structure is one or more of the following: 1) one or more of the following: 1) one or more of the following: 1) a rail-changing guide rail mounted on the ground, a vehicle or a vehicle bogie having a rail-changing guide wheel, performing up-and-down movement switching, and guiding or separating from the rail-changing guide rail to change the rail of the vehicle; 2) in the turnout interval, a rail-changing guide rail mounted on the ground is provided, the vehicle or the vehicle bogie is provided with a rail-changing guide wheel, left-right horizontal movement switching is performed, and the rail-changing guide rail cooperates with or separates from the rail-changing guide rail, so that the vehicle is rail-changed; and 3) in the turnout interval, There is a rail-changeable guide wall mounted on the ground, the main rail has a rail edge or an inner and outer guide rail, the vehicle or the vehicle bogie is provided with a rail-changing guide wheel for horizontally motion and switching left and right to be guided or separated from the rail-changing guide wall, and the main steel wheel is guided in cooperation with the rail edge or the inner and outer guide rail to change the rail of the vehicle.

11. The motion mechanism of the steel rail track and steel wheel vehicle according to claim 8, **characterized in that**: in the rhombic cross section, the following structure is used: 1) the main steel rail has no movable part, and the auxiliary rail can rotate; during switching, the tread portion of the movable end of the auxiliary rail has an extension arm, passes over the main steel rail from above the main steel rail, and is connected to the tread portion of the fixed end of the auxiliary rail by means of an inclined seam or a sawtooth seam, so that the auxiliary rail guide wheel of the vehicle does not roll over the gap of the auxiliary rail guide tread without segment difference to guide; or, 2) neither the main steel rail nor the auxiliary rail is movable; in the rhombic cross section, the auxiliary rail is not laid; the auxiliary rail guide wheel pair and the auxiliary rail contact assembly pair are not extruded when passing through the auxiliary rail interruption section, so that after passing through the auxiliary rail interruption section, The main steel rail is provided with an outer guide rail or an inner guide rail, or the main steel rail becomes a steel rail with an outer rail edge or an inner rail edge, and the guide rail or the rail edge guides the main steel wheel in a matched manner, so that the auxiliary rail guide wheel pair and the auxiliary rail contact assembly pair smoothly pass through the rhombic cross section.

12. The motion mechanism of the steel rail track and steel wheel vehicle according to claim 8, **characterized in that** there is no movable part between the crossing section, the main steel rail and the auxiliary rail; and the auxiliary rail is not laid; the auxiliary rail guide wheel pair and the auxiliary rail contact assembly pair are not extruded when passing through the auxiliary rail interruption section, so that after passing through the auxiliary rail interruption section, the auxiliary rail guide wheel pair and the auxiliary rail contact assembly are smoothly re-sleeved on two sides of the auxiliary rail; and the main steel rail has an outer guide rail or an inner guide rail, or the main steel rail becomes a steel rail with an outer rail edge or an inner rail edge, and the guide rail or the rail edge guides the main steel wheel, so that the auxiliary rail guide wheel pair and the auxiliary rail contact assembly pair smoothly pass through the crossing section.

13. The motion mechanism of the steel rail track and steel wheel vehicle according to claim 8, wherein the train vehicle is provided with a steering operating rod or a steering wheel, and the main steel wheel is operated to go straight or steer on the ground outside the main steel rail or the steel rail.

14. The motion mechanism of the steel rail track and steel wheel vehicle according to claim 8, **characterized in that** the vertical rolling wheel is mounted on a bogie below the vehicle body, or is directly mounted on the vehicle body when there is no bogie, and is located below the auxiliary rail upper wing and higher than the main steel rail tread; the vertical rolling wheel is mounted on the rigid or elastic support body, and usually does not contact the lower surface of the upper wing of the auxiliary rail; when the vehicle is lifted upwards to be large, rolling contact is performed to define a large upward movement; or, the vertical rolling wheel is mounted on the elastic support body, usually rolling and contacting the lower surface of the upper wing of the auxiliary rail, and defining a large left-right movement or upward movement.

15. A motion mechanism of steel rail track and steel wheel vehicle comprising one or both of a track and a vehicle, wherein the track comprises: two main steel rails and a turnout, forming a ballastless track or a ballast track, and having or without a linear motor auxiliary track; The vehicle comprises: a vehicle body, a main steel wheel without a rim, and a horizontal guide wheel of the main steel rail; the tread of

the main steel wheel is a conical surface, and the left and right main steel wheels and the wheel shaft form a rigid wheel pair; or, the tread of the main steel wheel is a cylindrical surface, and the left and right main steel wheels are independent rolling wheel pairs; and the rail and the vehicle have the following features:

(1) the distance between the main steel rails is 1435 mm standard gauge, a wide gauge length greater than 1435 mm, or a narrow gauge length less than 1435 mm; when the main steel wheel is a conical surface tread, the seam in the length direction of the main steel rail is a weld seam, an inclined seam, or a straight seam; when the main steel wheel is a cylindrical tread, the seam is a weld seam, an inclined seam, a sawtooth seam, or a straight seam;

(2) the auxiliary rail is provided with a stator or a rotor of a linear motor, and the upper surface of the auxiliary rail is not lower than the tread of the main steel rail; correspondingly, a rotor or a stator of a matched linear motor higher than the tread of the main steel rail is mounted on the vehicle;

(3) The main steel wheel is mounted on the bogie below the vehicle body, or is directly mounted on the vehicle body when there is no bogie, and rolls on the upper surface of the main steel rail to support the weight of the vehicle; the main steel wheel is a driving wheel, a braking wheel, or a driven wheel, or is switched to a state of a driving wheel, a braking wheel, or a driven wheel according to control; during normal operation of the straight line and the curve segment outside the turnout, the rhombus intersection and the crossing, when the main steel wheel is a conical surface tread, the main steel wheel is matched and guided with the main steel rail; when the main steel wheel is a cylindrical surface tread, the horizontal guide wheel is matched and guided with the inner side or the outer side tread of the main steel rail, and the main steel wheel is not guided;

(4) A main steel wheel on the vehicle, a horizontal guide wheel of the main steel rail, a bogie mounted below the vehicle body, or directly mounted on the vehicle body when there is no bogie; the two horizontal guide wheels are located on the inner sides of the two main steel rails, the outer sides of the two main steel rails, the inner side and the outer side of one main steel rail, the weight of the vehicle is not supported, and the horizontal guide wheel is in contact with or not in contact with the inner side or the outer side of the main steel rail; the tread material is a metal alloy or a wear-resistant material of an artificial stone; for a cylindrical tread main steel wheel and two inner side horizontal guide wheels, generally guide and turnout orbital transfer guide of a straight line segment and a curve segment which do not intersect are performed; two inner side horizontal guide wheels, relative to a main steel wheel of a vehicle, do not move left and right as a whole, or have a small left-right movement amount, In order to absorb the laying straightness tolerance of the auxiliary rail, it is avoided that guiding or extruding of the straight line segment interferes with the inertial linear movement of the train, so that the movement of the train is more stable; but the left and right movement amounts are limited in order to prevent derailment; the left-right movement amount is small, the guiding force of the two inner-side horizontal guide wheels is smaller than the guiding force of the tread of the conical face of the main steel wheel, and the main steel wheel is guided; but when the main steel rail moves left and right to increase the possibility of derailment, the two inner horizontal guide wheels do not move left and right as a whole, or have a small left-right movement amount but a limited left-right movement amount, so as to prevent derailment; in addition, at the turnout change rail, the left-right movement amount of the main steel rail is large, the two inner-side horizontal guide wheels do not move left and right as a whole, or has a small left-right movement amount but a limited set value of left and right movement amounts, and the guiding force of the horizontal guide wheel is greater than the guiding force of the tread of the conical face of the main steel wheel, and the horizontal guide wheel is guided;

(5) in the turnout section, the linear motor auxiliary rail is not laid; the switch rail section of the main steel rail is driven by the switch machine to swing left and right, no matter whether the main steel wheel is a conical surface tread or a cylindrical tread, and the two inner side horizontal guide wheels are matched and guided with the switch rail of the main steel rail to change the rail;

(6) Driving or braking of the vehicle includes one or more of driving or braking of the main steel rail and driving or braking of the auxiliary rail linear motor; the driving or braking of the main steel rail and the auxiliary rail adopts or does not adopt the following distribution: 1) when the driving force or braking force required by the vehicle is small, or the driving or braking of the main steel rail and the main steel wheel is sufficient, only the driving or braking of the main steel rail and the main steel wheel is used; 2) when the driving force or braking force required by the vehicle is large, or the driving or braking of the main steel rail and the main steel wheel is not

enough, the vehicle uses the driving or braking of the main steel rail and the auxiliary rail at the same time, or only uses the driving or braking of the auxiliary rail;

(7) the vehicle, the main steel wheel and the horizontal guide wheel of the vehicle can roll and run on a traditional steel rail with or without a standard gauge, a wide gauge, or a narrow gauge of the auxiliary rail of the linear motor;

(8) The main rail, the conventional gauge with or without the linear motor stator or rotor, the wide gauge, or the steel wheel of the narrow gauge train can roll and run above, and can roll through the switch; for a linear motor auxiliary rail higher than the upper surface of the main steel rail, the corresponding components below the traditional train are removed or modified, so that the lower portion of the train does not contact the auxiliary rail and can run in the whole process.

16. The motion mechanism of the steel rail track and steel wheel vehicle according to claim 15, wherein the rail is provided with a linear motor auxiliary rail, and the vehicle is provided with an auxiliary rail contact assembly pair higher than the main steel rail tread; the auxiliary rail contact assembly pair is one or more of the following: 1) a horizontal auxiliary wheel, 2) an auxiliary rail brake block, and 3) an auxiliary rail brake block plus a buffer wheel; the auxiliary rail contact assembly pair presses the auxiliary rail from left to right so as to drive, brake, or prevent derailment; the auxiliary rail contact assembly pair is greater than the overall left and right free movement amount of the vehicle main steel wheel, and is greater than the elastic movement amount of the horizontal guide wheel, so that when the main steel wheel is a conical surface tread, the matching guide of the conical surface of the main steel wheel and the upper surface of the main steel rail is not affected, Or when the main steel wheel is a cylindrical tread, the cooperative guidance of the horizontal guide wheel and the inner side surface of the main steel rail is not affected; and the overall left and right free movement amount of the auxiliary rail contact assembly pair is limited, so as to enhance the derailment prevention performance; and the overall left-right motion mechanism is as follows: 1) the auxiliary rail contact assembly is integrally mounted on a guide rail capable of freely sliding left and right; 2) the auxiliary rail contact assembly is integrally installed on a rotating shaft or a round hole capable of freely rotating left and right; 3) the auxiliary rail contact assembly pair is driven to extrude the auxiliary rail from left to right through the same air pressure pipeline, the same hydraulic pipeline or piston of the motor or magnetic attraction; and the air pressure pipeline, the hydraulic pipeline or the motor or the magnetic attraction only controls the extrusion force or loosening of the auxiliary rail contact assembly pair, At the same time, the auxiliary rail contact assembly moves freely in the left-right direction as a whole.

17. The motion mechanism of the steel rail track and steel wheel vehicle according to claim 15, wherein a horizontal driving wheel or a brake block is installed on the vehicle, and is extruded or matched with the horizontal guide wheel to extrude the main steel rail on the outer side, the inner side or the inner side and the outer side of the main steel rail to realize driving or braking; and the horizontal driving wheel or the brake block is increased in height between the turnout section, the rhombic cross section, the crossing section and the temperature telescopic adjuster section, so as not to collide with the main steel rail or other articles.

18. The motion mechanism of the steel rail track and steel wheel vehicle according to claim 17, **characterized in that**: at the front of the turnout section, the rhombus crossing section, the crossing section, and the temperature telescoping adjuster section, an ascending safety block is installed on the rail, and when the vehicle runs, the collision safety mechanism of the horizontal driving wheel or the braking block collides with the ascending safety block, so that the horizontal driving wheel or the braking block automatically releases the main steel rail and rises, and then keeps the vehicle in the ascending position to continue to run, so that the main steel rail or other articles do not touch; after the vehicle passes through the turnout section, the rhombic cross section, the crossing section and the temperature telescopic adjuster section, the horizontal driving wheel or the brake block on the vehicle again collides with the descending safety block installed on the rail, or triggers the light, electric, magnetic and other sensors, Automatic or manual operation drops to the outside or inside of the main rail to guide, prevent derailment, or squeeze the main rail for driving or braking.

19. The motion mechanism of the steel rail track and steel wheel vehicle according to claim 1 or 4, **characterized in that** the train vehicle is provided with an operation controller, and the turnout switch machine or the rhombic cross auxiliary rail rotating machine is controlled by wired or wireless communication to perform rail changing guiding or passing guiding.

20. The motion mechanism of the steel rail track and steel wheel vehicle according to claim 5 or 8, **characterized in that** the train vehicle is provided with an operation controller, and the turnout switch machine or the rhombic cross auxiliary rail rotating machine is

operated and controlled through wired or wireless communication to perform rail changing guiding or passing guiding.

21. The motion mechanism of the steel rail track and steel wheel vehicle according to claim 15, **characterized in that** the train vehicle is provided with an operation controller, and the turnout switch machine or the rhombic cross auxiliary rail rotating machine is controlled by wired or wireless communication to perform rail changing guiding or passing guiding.

22. The motion mechanism of the steel rail track and steel wheel vehicle according to claim 1 or 4, **characterized in that** the seat on the interior of the train is provided with a safety belt, so as to fix the passenger, so that the passenger is not opened at a large acceleration or deceleration, resulting in danger.

23. The motion mechanism of the steel rail track and steel wheel vehicle according to claim 5 or 8, **characterized in that** the seat on the interior of the train is provided with a safety belt, so as to fix the passenger, so that the passenger is not opened at a large acceleration or deceleration, resulting in danger.

24. The motion mechanism of the steel rail track and steel wheel vehicle according to claim 15, **characterized in that** the internal seat of the train is provided with a safety belt, so as to fix the passenger, so that the passenger is not opened at a large acceleration or deceleration, resulting in danger.

25. The motion mechanism of the steel rail track and steel wheel vehicle according to claim 5 or 8, **characterized in that** the cylindrical tread main steel wheel is an independent rolling wheel, a main steel wheel pair steering mechanism, or each main steel wheel independent steering mechanism, is mounted on the bogie, or is directly mounted on the vehicle body when there is no bogie; the front and rear wheel pairs or the front and rear wheels, the steering angles being the same, and the directions being opposite; the front and rear bogies of the vehicle body, the steering angles being the same, and the directions being opposite; and the size of the steering angle being matched with the turning radius of the rail.

26. The motion mechanism of the steel rail track and steel wheel vehicle according to claim 15, **characterized in that** the cylindrical tread main steel wheel is an independent rolling wheel, a main steel wheel pair steering mechanism, or each main steel wheel independent steering mechanism, is mounted on the bogie, or is directly mounted on the vehicle body when there is no bogie; the front and rear wheel pairs or the front and rear wheels, the steering angles being the same, and the directions being opposite; the front and rear bogies of the vehicle body, the steering angles being the same, and the directions being opposite; and the size of the steering angle being matched with the turning radius of the rail.

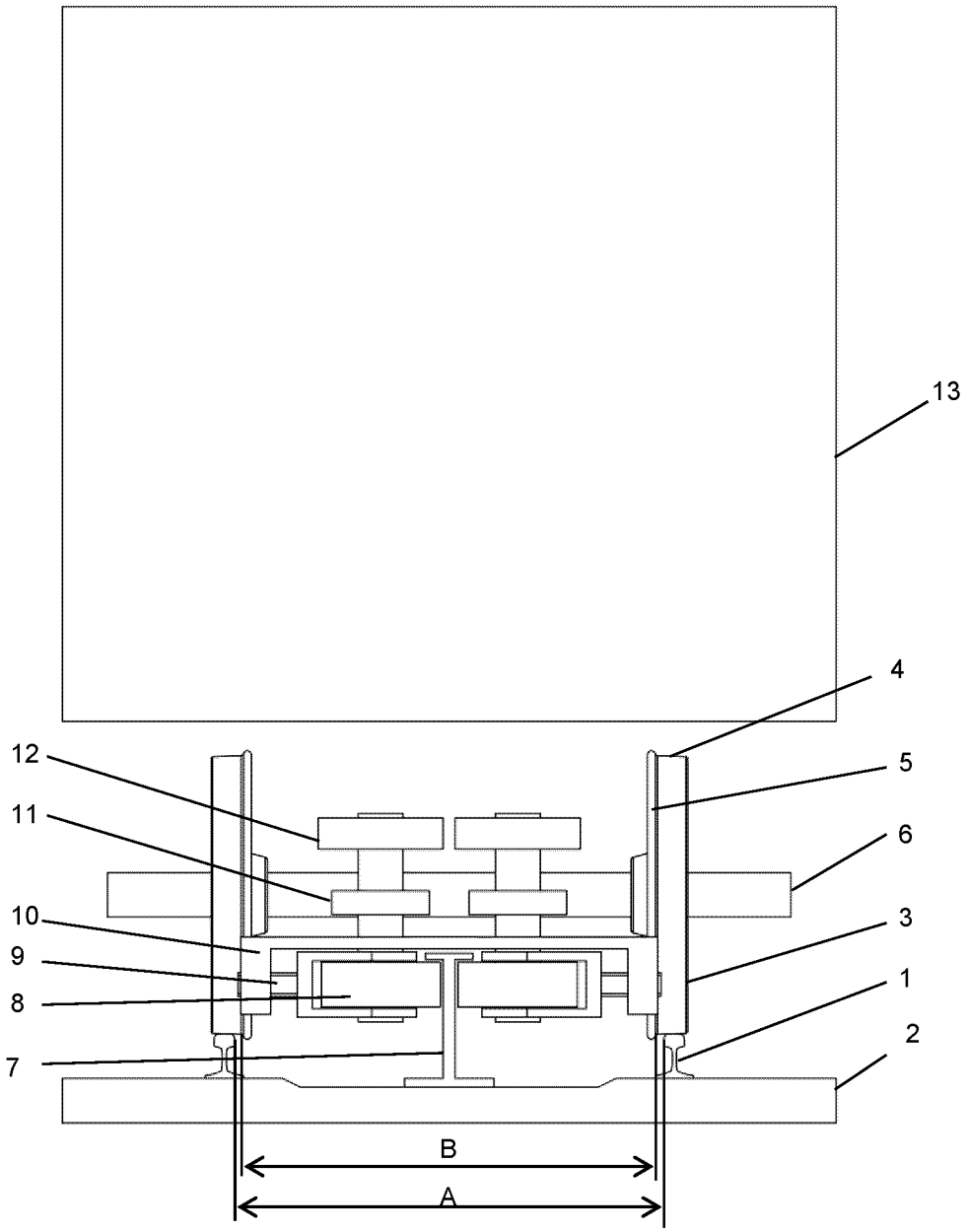

FIG. 1

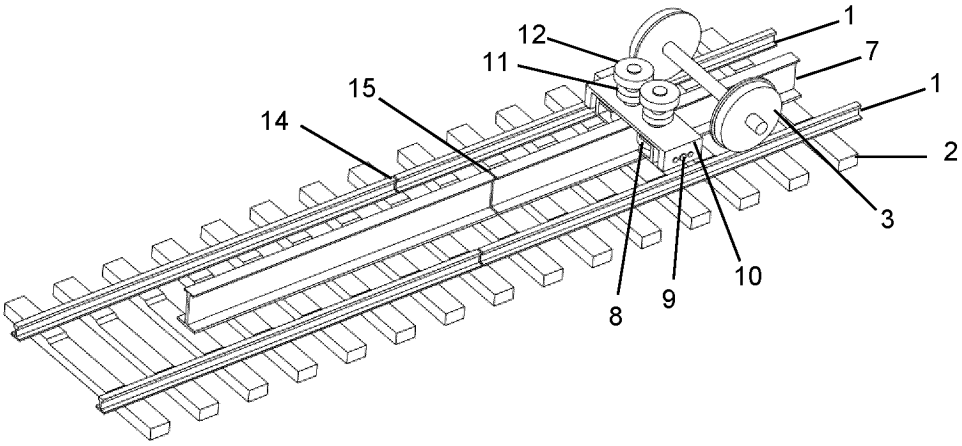

FIG. 2

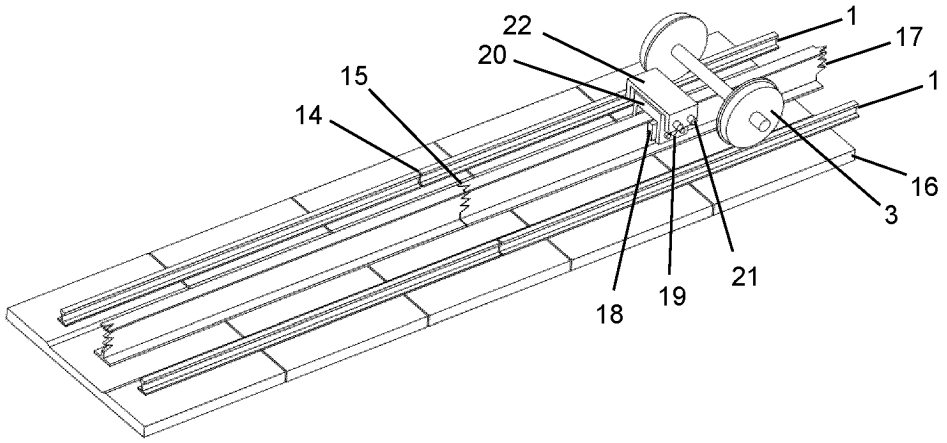

FIG. 3

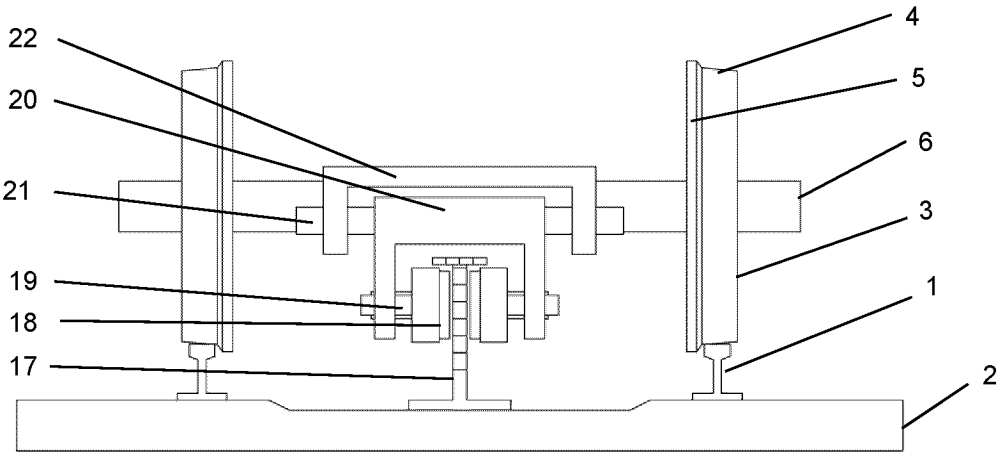

FIG. 4

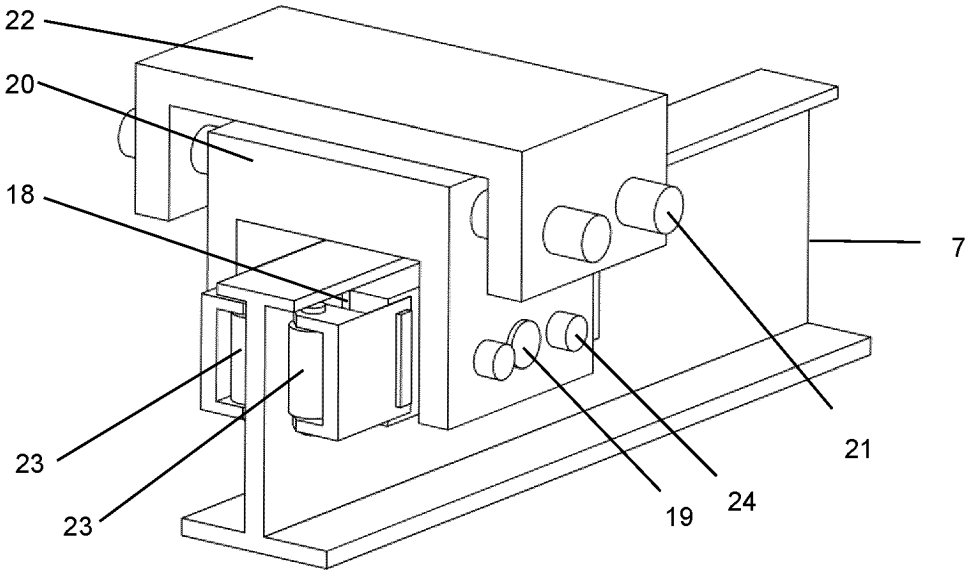

FIG. 5

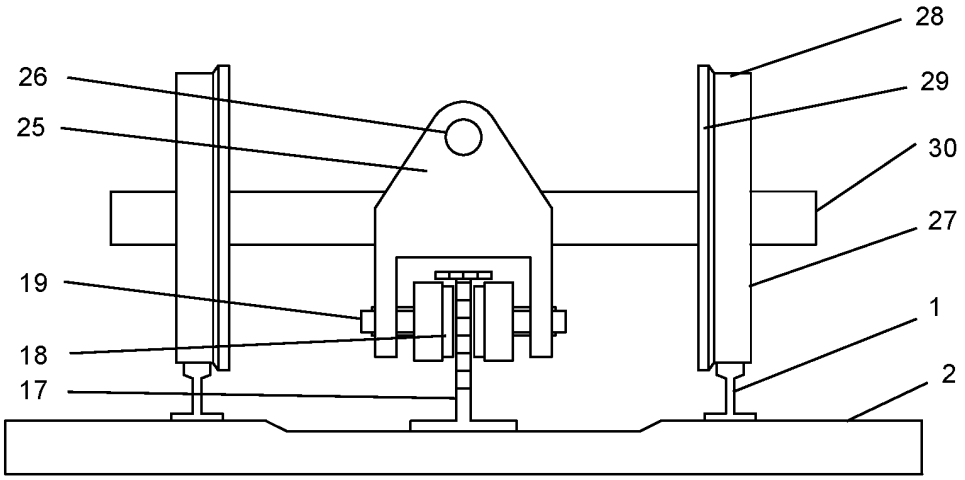

FIG. 6

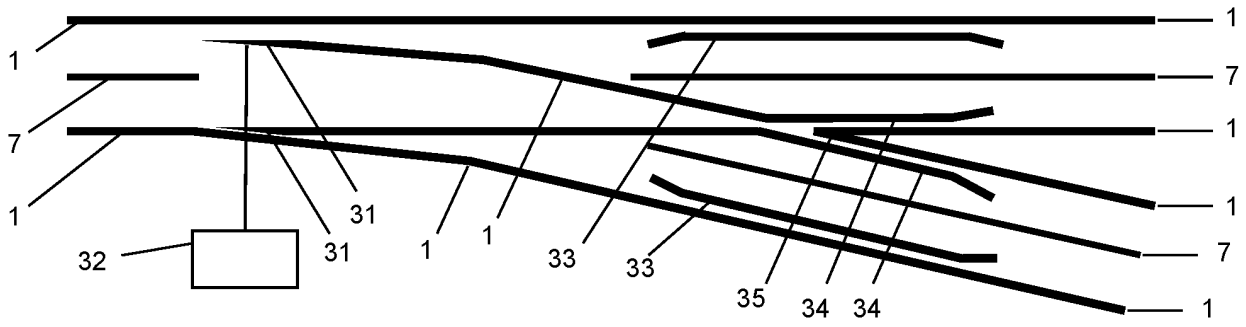

FIG. 7

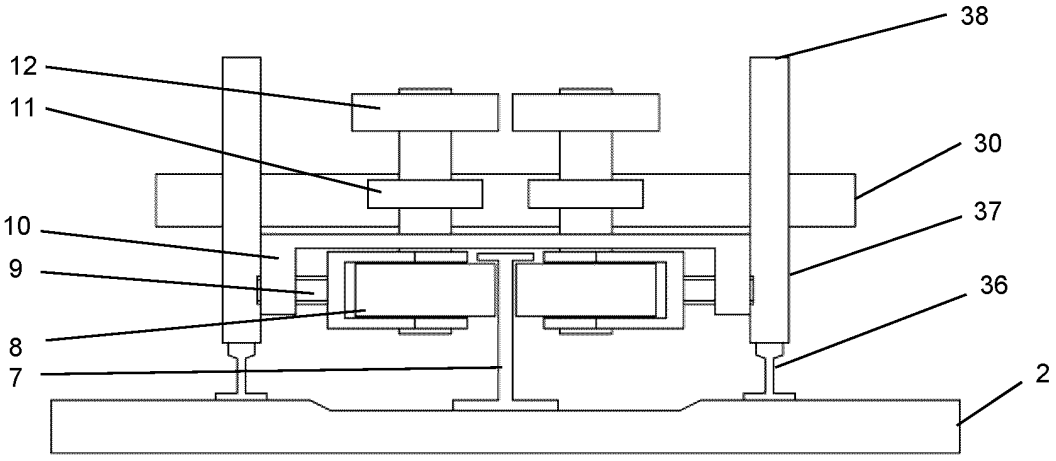

FIG. 8

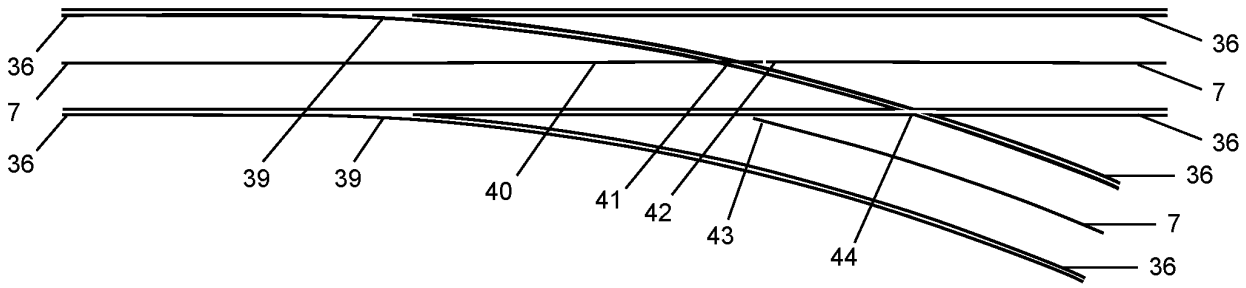

FIG. 9

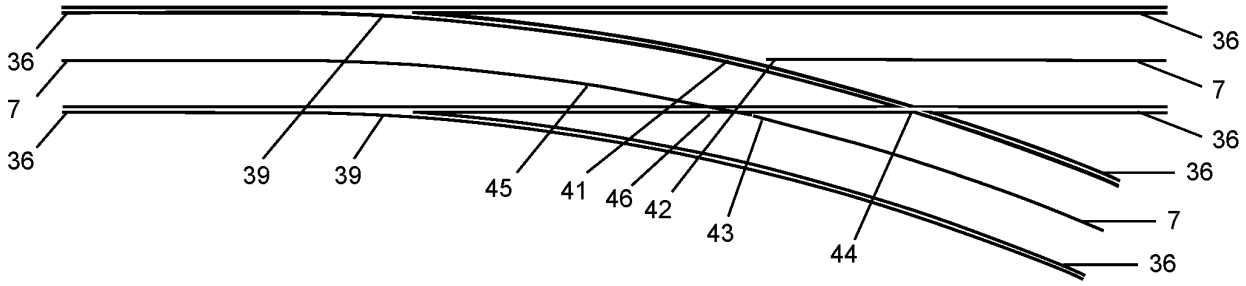

FIG. 10

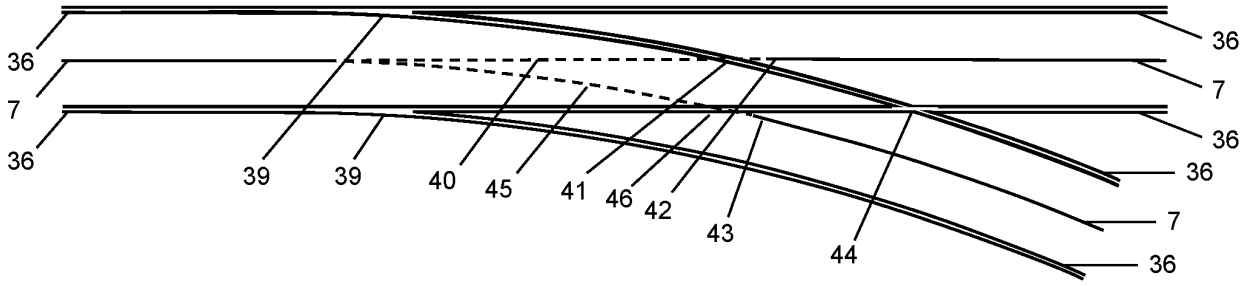

FIG. 11

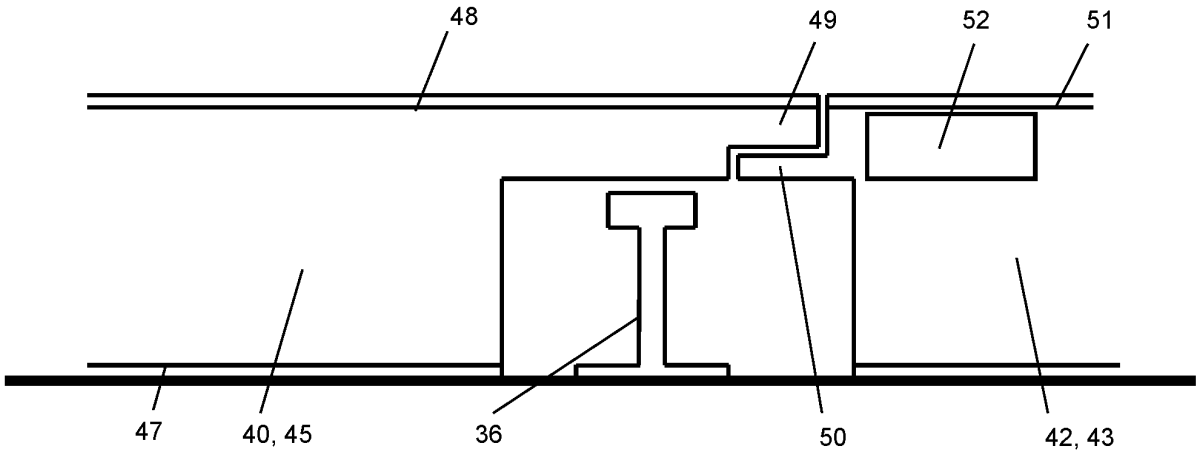

FIG. 12

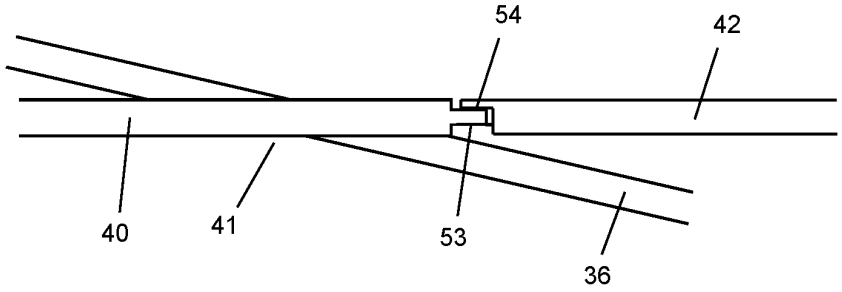

FIG. 13

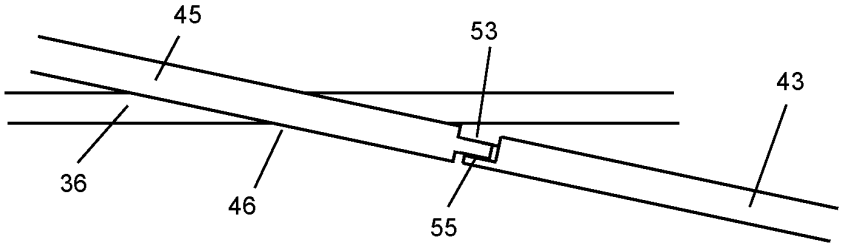

FIG. 14

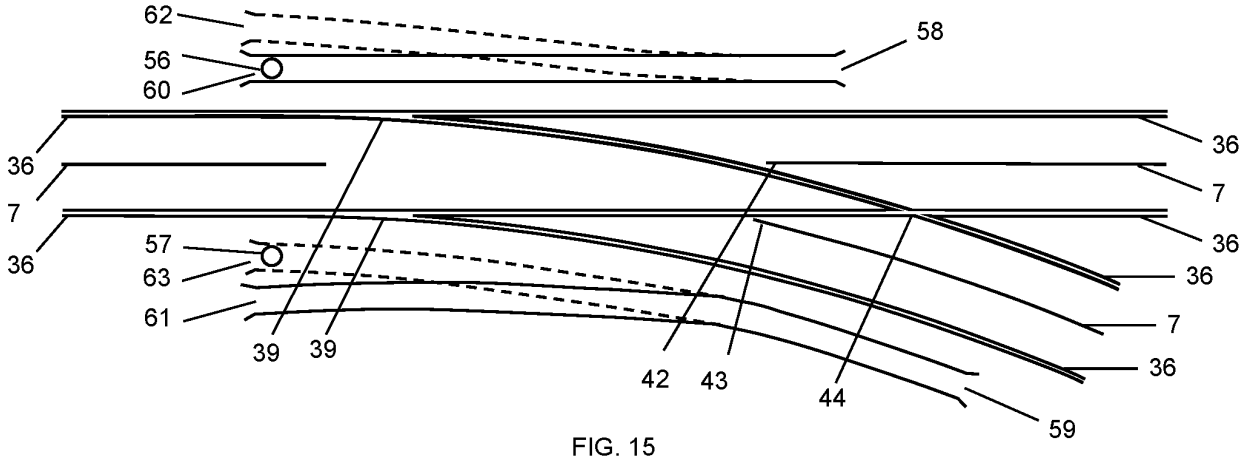

FIG. 15

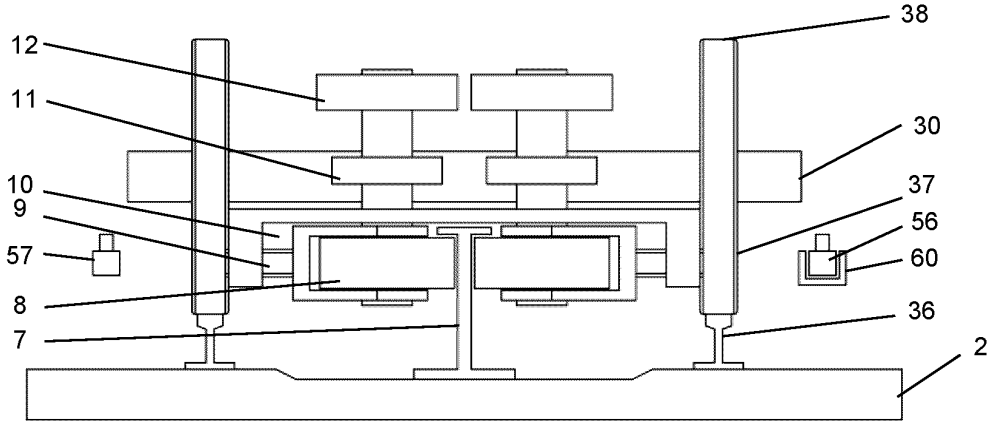

FIG. 16

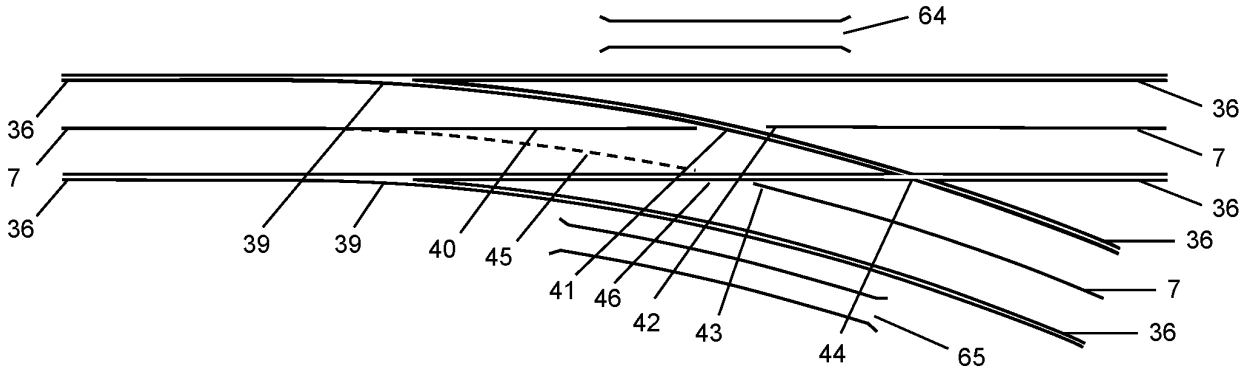

FIG. 17

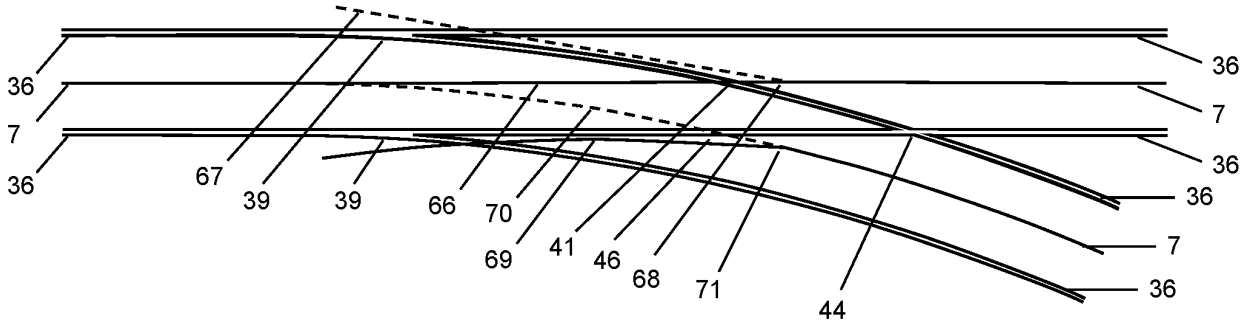

FIG. 18

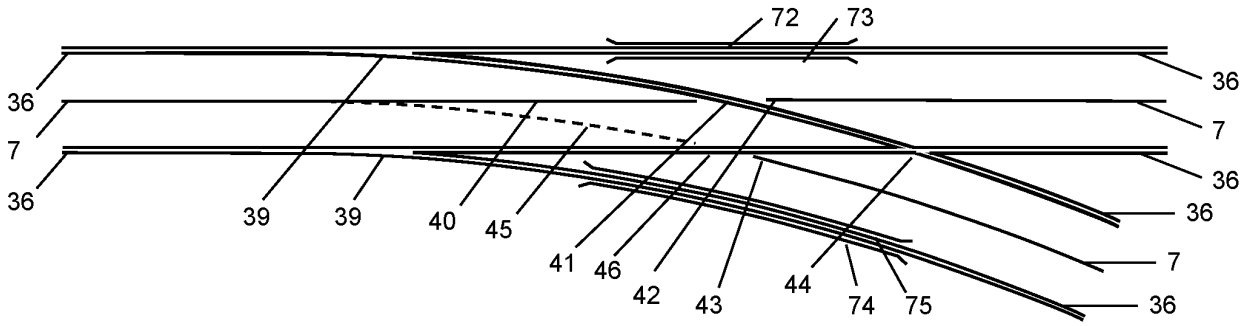

FIG. 19

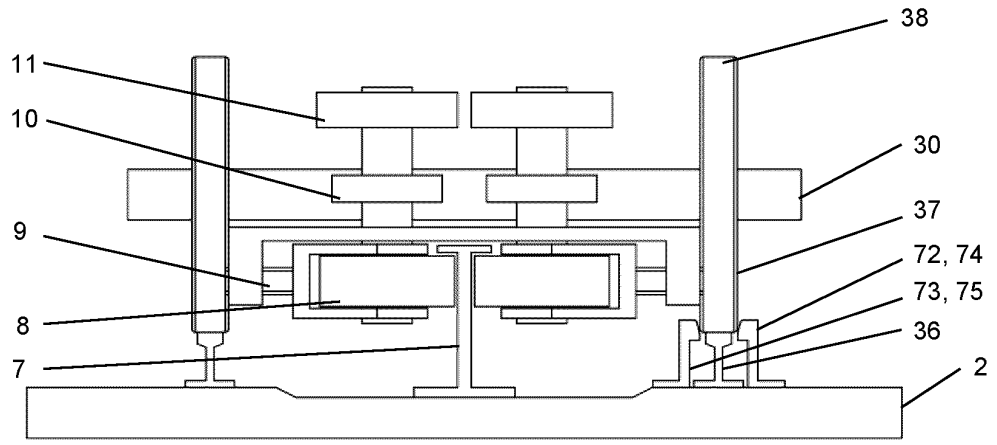

FIG. 20

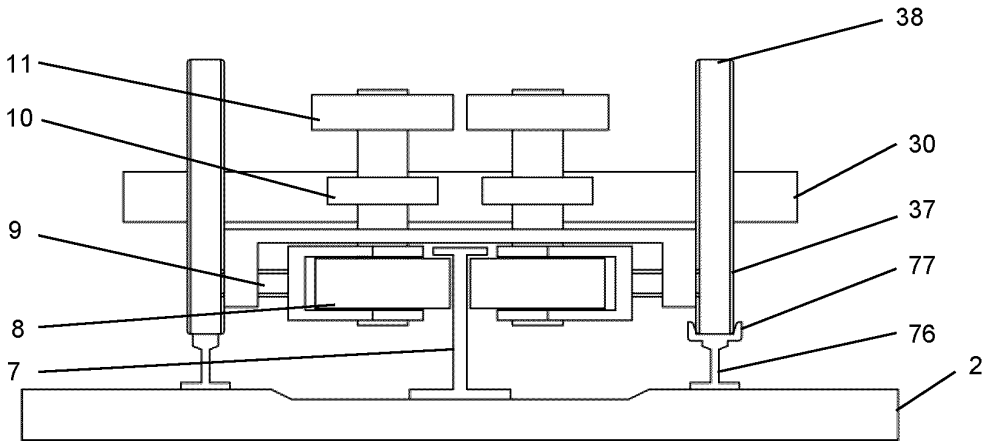

FIG. 21

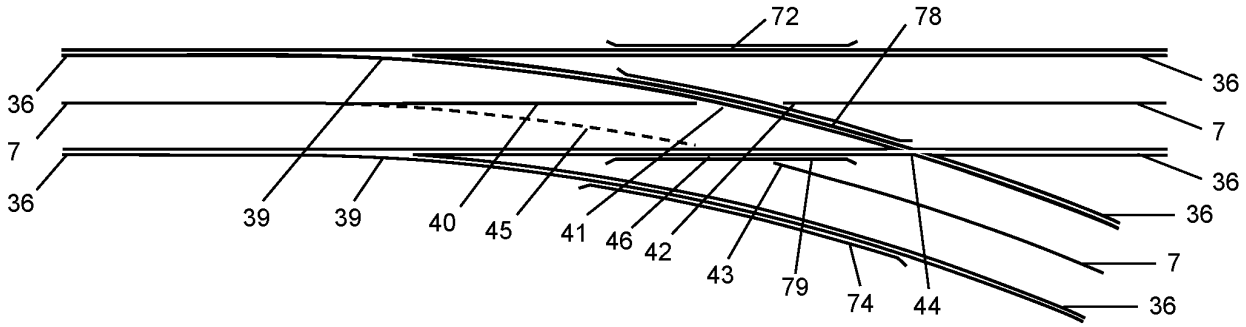

FIG. 22

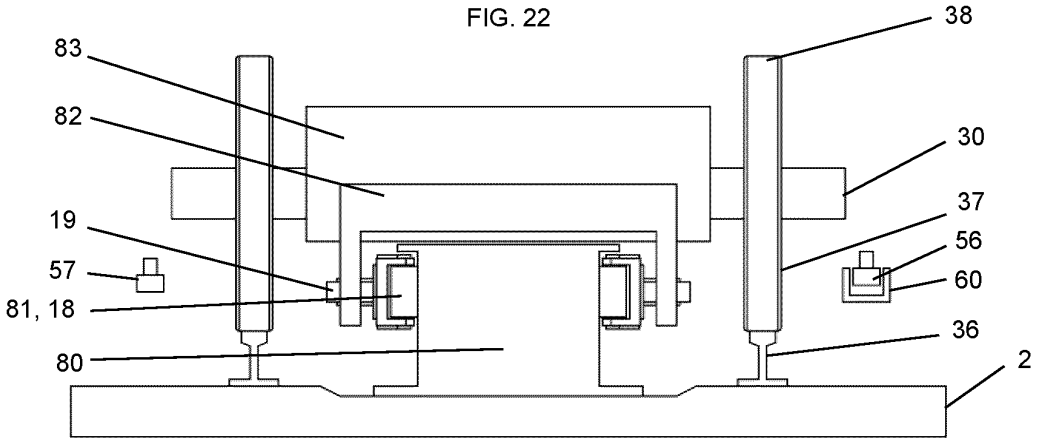

FIG. 23

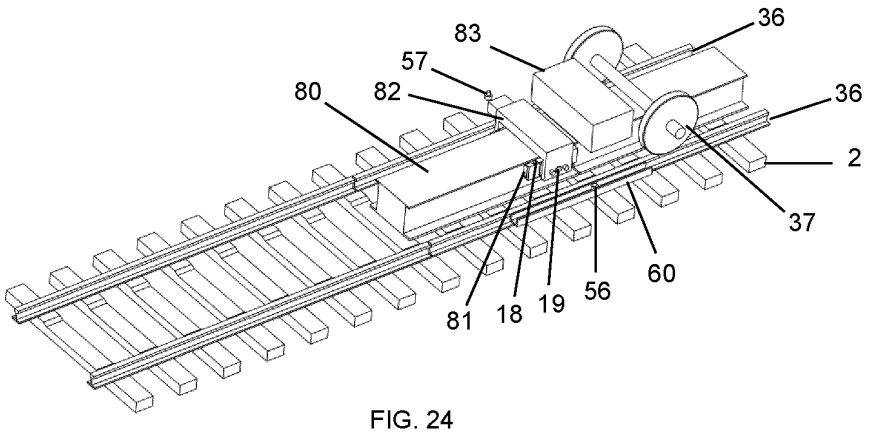

FIG. 24

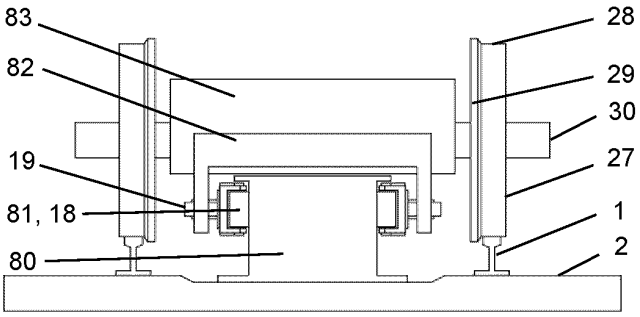

FIG. 25

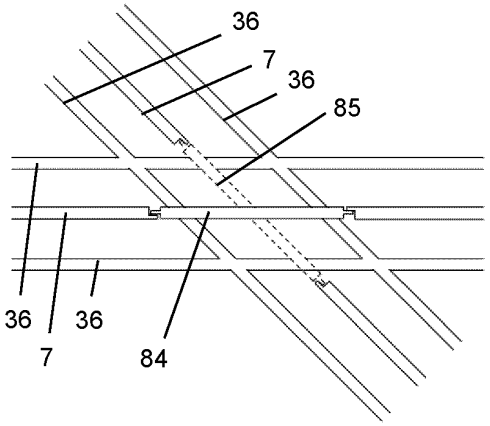

FIG. 26

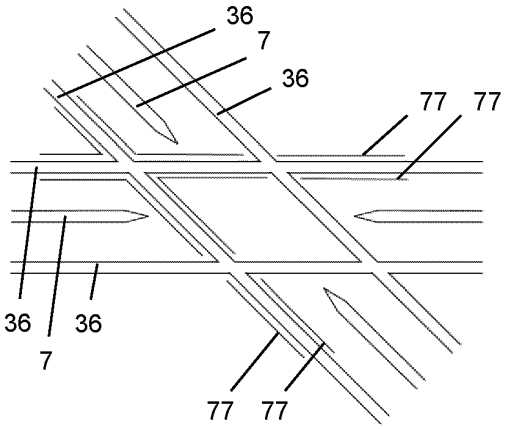

FIG. 27

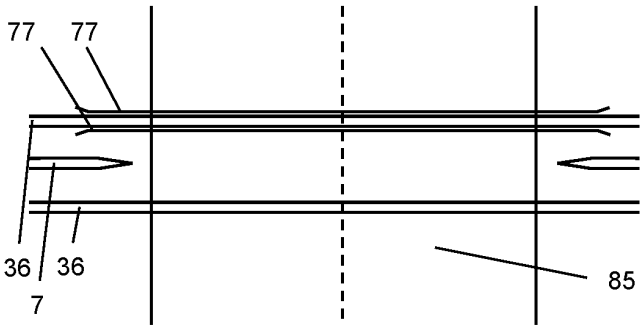

FIG. 28

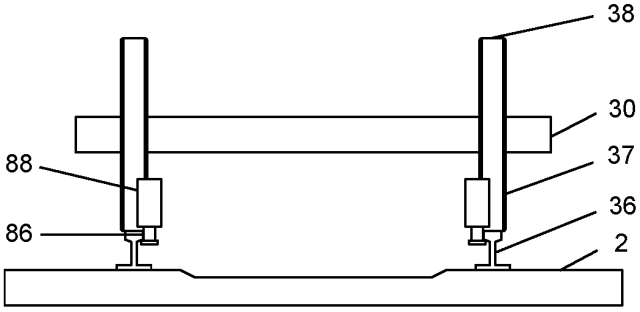

FIG. 29

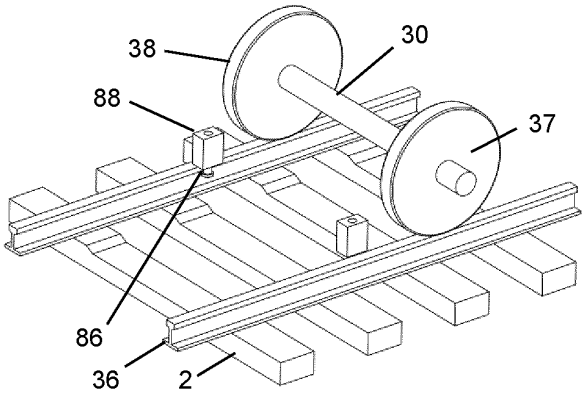

FIG. 30

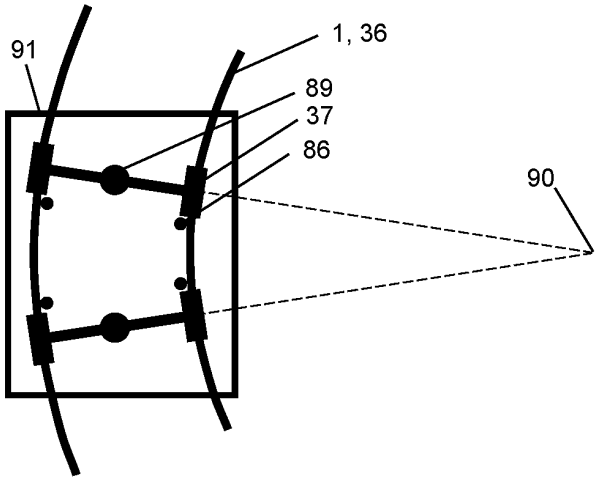

FIG. 31

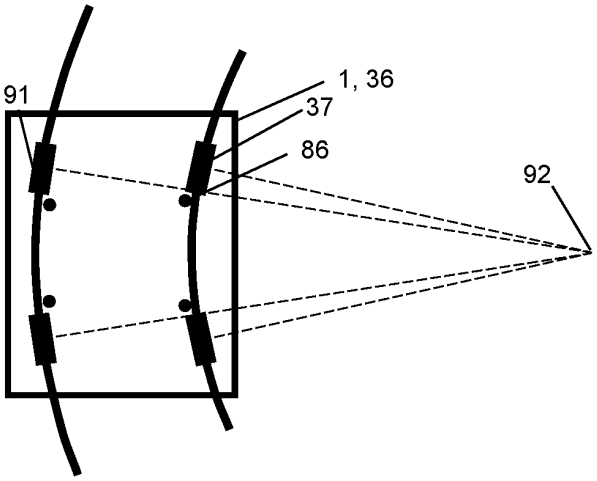

FIG. 32

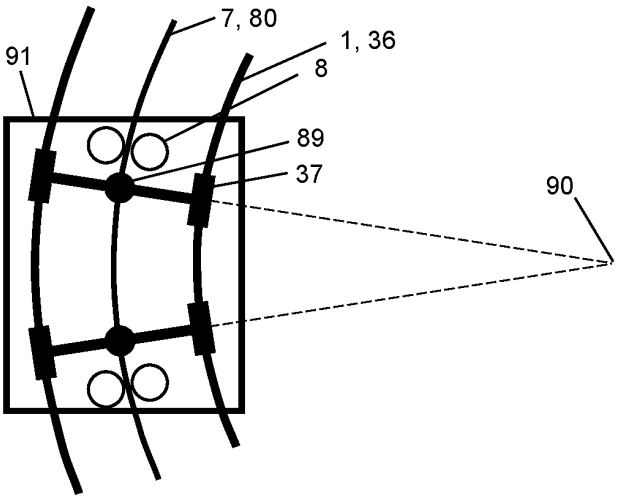

FIG. 33

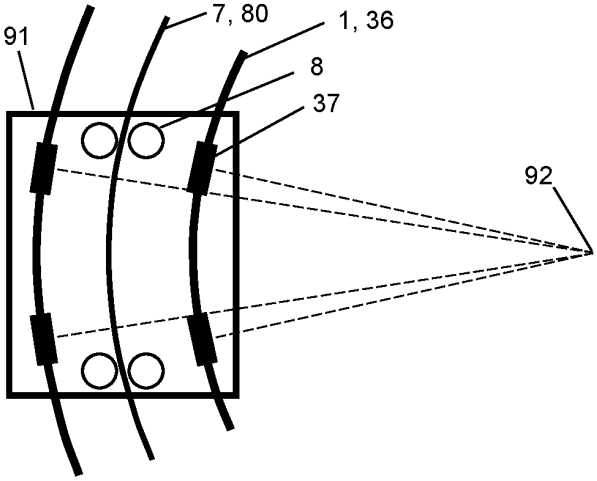

FIG. 34

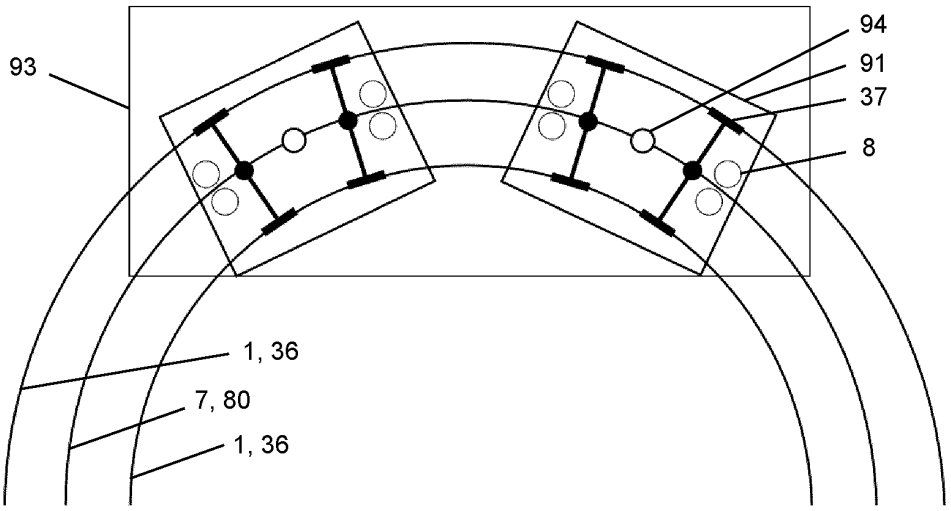

FIG. 35

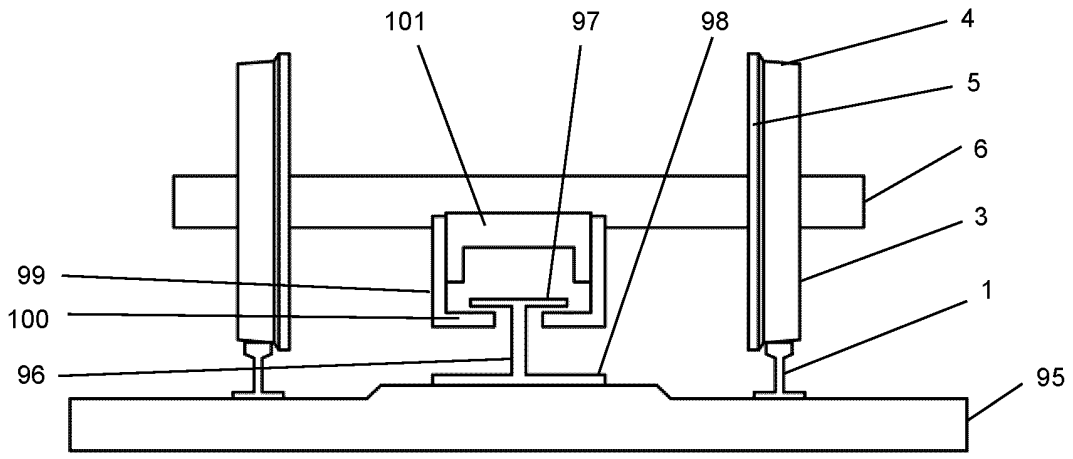

FIG. 36

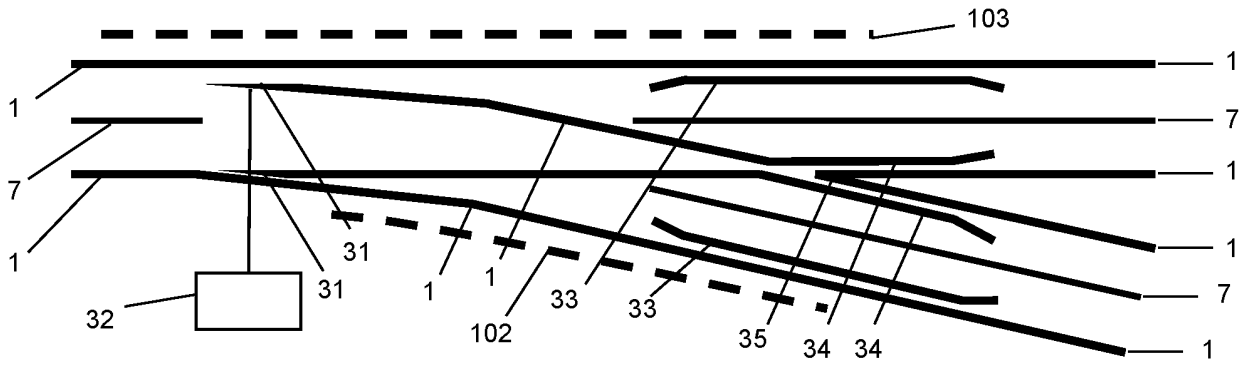

FIG. 37

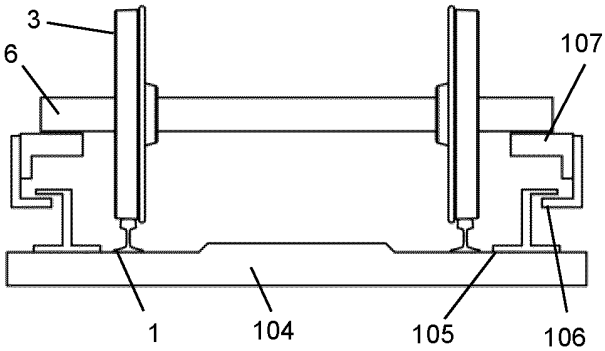

FIG. 38

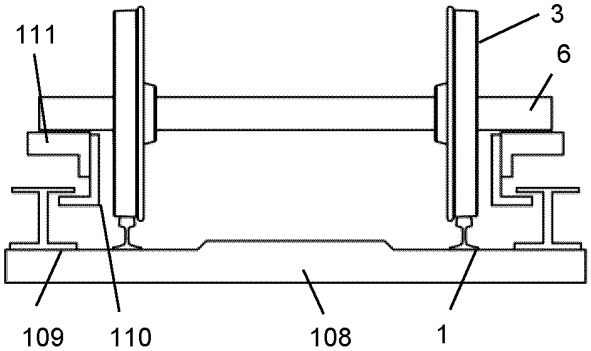

FIG. 39

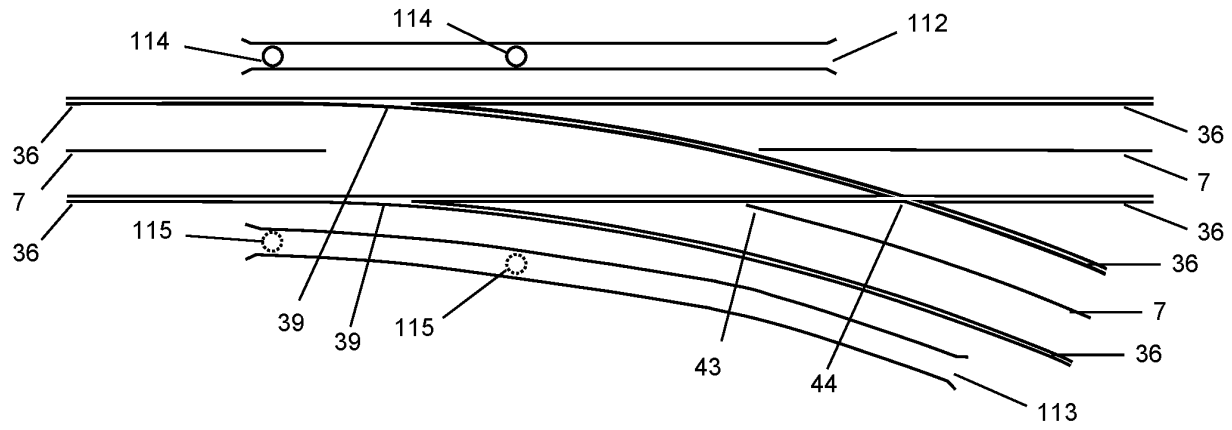

FIG. 40

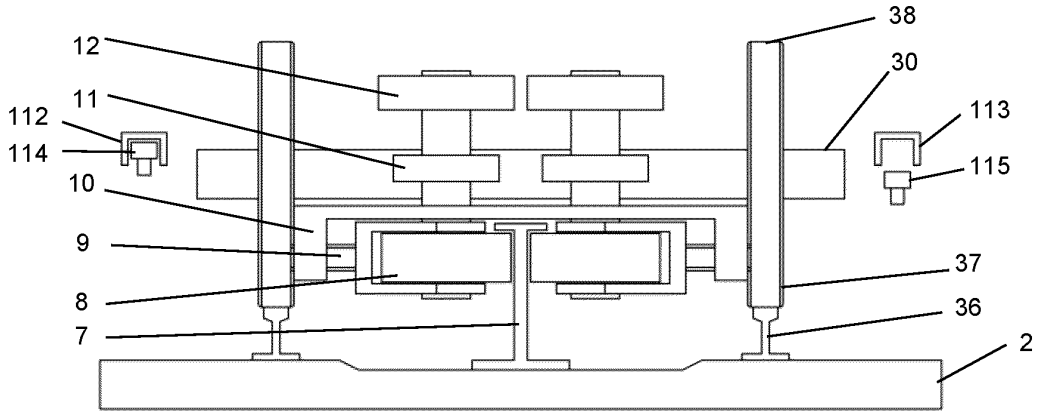

FIG. 41

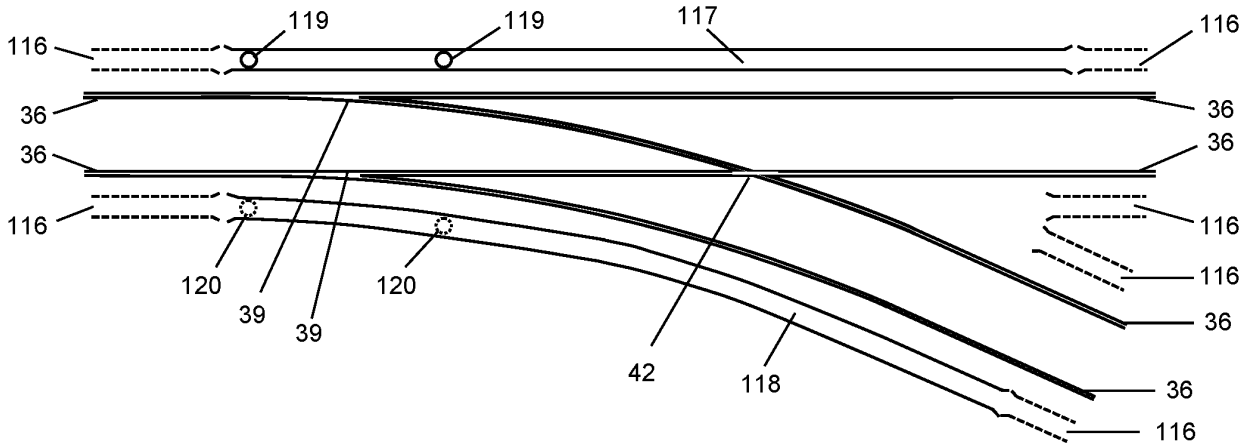

FIG. 42

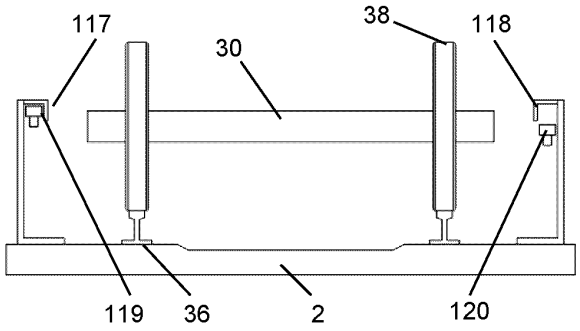

FIG. 43

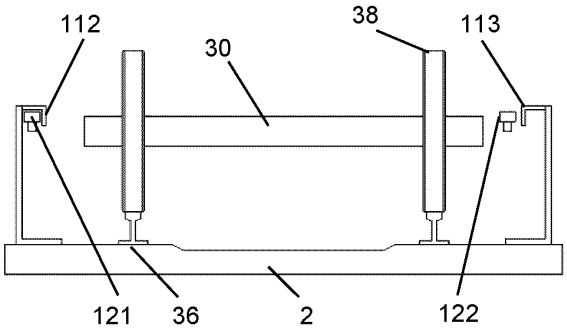

FIG. 44

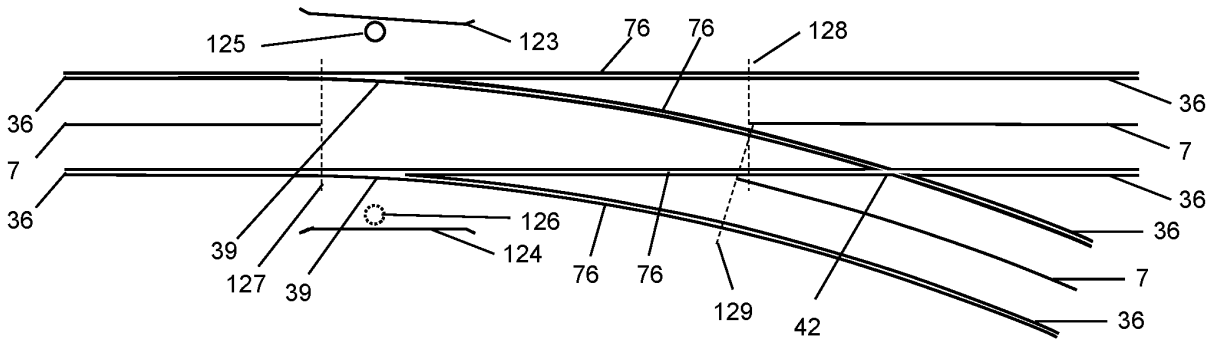

FIG. 45

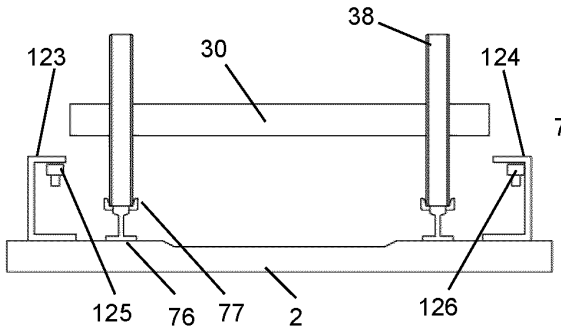

FIG. 46

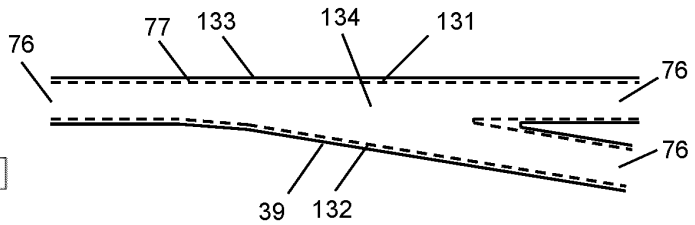

FIG. 47

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- CN 2023070021 W **[0001]**
- US 63303000 **[0001]**
- US 63331029 **[0001]**
- CN 2871610 Y **[0029]**
- CN 102190005 B **[0029]**
- CN 201924244 U **[0029]**
- WO 2011109928 A1 **[0029]**
- CN 107380008 A **[0029]**
- JP 4405904 B **[0029] [0098]**
- JP 4723282 B **[0030] [0097]**
- CN 106480789 A **[0030]**
- JP 2008024126 A **[0030]**
- CN 113029613 A **[0030]**
- CN 202200989 U **[0030]**
- JP 5297217 B **[0097] [0100]**