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(54) PIGGYBACK VEHICLE AND VEHICLE BODY THEREOF

(57) A piggyback vehicle and a vehicle body thereof are provided. The vehicle body includes a body part (1) and a holding part (4), each of two longitudinal ends of the holding part (4) is provided with a connection structure, and the connection structure includes an upper hook (421) and a lower circular shaft (412c) extending in a transverse direction. The body part (1) is provided with an end connecting mechanism (22), the end connecting mechanism (22) includes an end connecting hook (221) and an end longitudinal support member (222), and an upward hook opening is defined by the end connecting hook (221). In an assembled state, the lower circular shaft (412c) may be hung on the hook opening of the end connecting hook (221), and the upper hook (421) may be clamped onto the end longitudinal support member (222). With this structure, there are two connection points between each of the two longitudinal ends of the holding part (4) and the body part (1), and thus the connection between the holding part (4) and the body part (1) is reliable; and during separation, by lifting the body part (1), the body part (1) and the holding part (4) are able to rotate with respect to each other by taking a central axis of the lower circular shaft (412c) as a rotational center line, forcing the junction between the upper hook (421) and the end longitudinal support member (222) to be loosened, thus facilitating the separation between the holding part (4) and the body part (1).

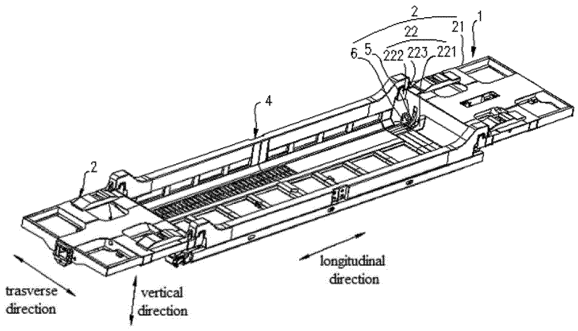

Figure 1

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Description

[0001] This application claims the benefit of priorities to Chinese Patent Application No. 2020101306274, titled "PIGGYBACK VEHICLE AND VEHICLE BODY THEREOF", filed with the China National Intellectual Property Administration on February 28, 2020 and Chinese Patent Application No. 202020236278X, titled "PIGGYBACK VEHICLE AND VEHICLE BODY THEREOF", filed with the China National Intellectual Property Administration on February 28, 2020, both of which are incorporated herein by reference in their entireties.

FIELD

[0002] The present application relates to the technical field of piggyback vehicles, and in particular to a piggyback vehicle and a vehicle body thereof.

BACKGROUND

[0003] Piggyback transportation refers to a convenient transportation mode in which road vehicles such as trucks or semi-trailers loaded with goods drive onto the piggyback vehicle at the departure station, undergo long-distance transportation by railway, and drive off the piggyback vehicle after arriving at the destination station, and then drive to the final destination.

[0004] The vehicle body of the piggyback vehicle may generally include a body part and a detachable holding part. When loading or unloading is required, the holding part may be detached from the body part, so that the road vehicles can drive on or off conveniently. After the loading or unloading is completed, the holding part may be mounted on the body part. In such a solution, the connection structure between the holding part and the body part is very important.

[0005] In view of this, a technical problem to be addressed by those skilled in the art is to provide a vehicle body of a piggyback vehicle.

SUMMARY

[0006] An object of the present application is to provide a piggyback vehicle and a vehicle body thereof, and the holding part and the body part of the vehicle body are able to be connected reliably and easy to be separated.

[0007] In order to solve the above technical problems, a vehicle body of a piggyback vehicle is provided according to the present application, which includes a body part and a holding part. Each of two longitudinal ends of the holding part is provided with a connection structure, and the connection structure includes an upper hook and a lower circular shaft extending in a transverse direction. The body part is provided with an end connecting mechanism, the end connecting mechanism includes an end connecting hook and an end longitudinal support member, and an upward hook opening is defined by the end connecting hook. In the assembled state, the lower circular shaft may be hung on the hook opening of the end connecting hook, and the upper hook may be clamped onto the end longitudinal support member.

[0008] With this structure, two connection points, one formed between the upper hook and the end longitudinal support member and the other formed between the lower circular shaft and the end connecting hook, are provided between each of the two longitudinal ends of the holding part and the body part, thus the connection between the holding part and the body part is more reliable. Besides, during separation, by lifting the body part, the body part and the holding part may rotate with respect to each other by taking the central axis of the lower circular shaft as the rotational center line, forcing the junction between the upper hook and the end longitudinal connecting member to become loose, thus facilitating the separation of the holding part and the body part.

[0009] Optionally, a clamping face, where the upper hook is clamped to the body part, of the upper hook includes a top face section and two side face sections. In the two side face sections, a first side face section may be a vertical face, and a second side face section may be an inclined face which is inclined from top to bottom in a direction away from the first side face section; or, each one of the two side face sections may be an inclined face which is inclined from top to bottom in a direction away from the other one.

[0010] Optionally, each of the two side face sections is provided with a holding part wear plate, and a shear-resisting stop structure is provided between the holding part wear plate and the side face section.

[0011] Optionally, the holding part includes a bottom wall and two side walls connected to the bottom wall, each of two longitudinal ends of each of the two side walls is provided with the upper hook; the side wall is further provided with a guide limiting member configured for cooperating with a limiting guide member of the body part, to guide the mounting of the holding part and limit the holding part in the transverse direction.

[0012] Optionally, the bottom wall includes an intermediate wall body and an end wall body located at each of two longitudinal sides of the intermediate wall body. The end wall body includes a main body portion and a connecting portion, and the main body portion employs a box structure. The lower circular shaft is mounted at an end of the main

body portion away from the intermediate wall body. The intermediate wall body includes two longitudinal beams spaced apart in the transverse direction, and the two longitudinal beams are connected by multiple transverse beams spaced apart in a longitudinal direction. Each of the longitudinal beams includes a flat beam section and a grid beam section, and the flat beam section includes a flat plate and multiple reinforcing beams mounted at a bottom of the flat plate. The grid beam section includes multiple small crossbars spaced apart in the longitudinal direction.

[0013] Optionally, the intermediate wall body is further provided with a longitudinal positioning structure; and/or, the intermediate wall body is further provided with a rotation center insertion connection portion; and/or, the bottom wall is further provided with a connection mounting position; and/or, the bottom wall further includes an inclined wall body gradually inclined upward from inside to outside, the inclined wall body is located at each of two transverse sides of the intermediate wall body and is used to connect the intermediate wall body and the side wall.

[0014] Optionally, an inner hook face of the end connecting hook is provided with an end groove extending in the transverse direction an inner surface of the end groove forms an end guide face for guiding the lower circular shaft to slide in. The end guide face is also configured to cooperate with the lower circular shaft, to guide the holding part and the body part to be separated from each other in a rotational manner.

[0015] Optionally, the end longitudinal support member includes an end longitudinal support body and an end wear plate fixed at each of a front end and a rear end of the end longitudinal support body, the end longitudinal support body is configured for the upper hook to hook onto, and in a hooking state, the end wear plate at the front end abuts against a front side of an inner hook face of the upper hook, and the end wear plate at the rear end abuts against a rear side of the inner hook face of the upper hook.

[0016] Optionally, the end connecting mechanism further includes an end transverse limiting member. The end transverse limiting member is located above the end connecting hook and in front of the end longitudinal support member, the end transverse limiting member includes an end transverse limiting groove, and the end transverse limiting groove is configured to cooperate with the guide limiting member of the holding part, to guide the mounting of the holding part and limit the holding part in the transverse direction.

[0017] Optionally, the body part is further provided with a locking mechanism for locking or unlocking the holding part in an up and down direction; and/or, the body part is further provided with a transverse stop mechanism; in a stopping state, the transverse stop mechanism may is used to stop the holding part in the transverse direction; in an unblocking state, the transverse stop mechanism is used to release the stopping of the holding part.

[0018] Optionally, the end connecting hook includes an end hook body, the end hook body includes two end hook sub-bodies spaced apart in the transverse direction and an end accommodation cavity formed between the two end hook sub-bodies, and the locking mechanism is mounted in the end accommodation cavity; and/or, the transverse stop mechanism is mounted on a transversely outer side of the end connecting hook.

[0019] Optionally, the locking mechanism includes: a first lock body, wherein the first lock body is hinged with the end connecting hook, one end of the first lock body is a locking end, another end of the first lock body is a first limiting end, and a third hinge shaft of the first lock body is located between the locking end and the first limiting end; a first limiting portion, wherein the first limiting portion is fixed in the end accommodation cavity; and a first locking and driving beam assembly connected with the first lock body. In a locked state, the first limiting end abuts against the first limiting portion from top to bottom, the locking end abuts against the holding part, to lock the holding part; in an unlocked state, the first locking and driving beam assembly may drive the first limiting end to be disengaged from the first limiting portion from bottom to top, and the locking end to rotate to be separated from the holding part.

[0020] Optionally, the first locking and driving beam assembly includes a first push beam, a first guide sleeve and a transmission beam. The first guide sleeve is fixed in the end accommodation cavity, the first push beam is slidably connected to the first guide sleeve, and the transmission beam has one end hinged with the first lock body and another end hinged with the first push beam.

[0021] Optionally, a first elastic piece is further provided, one end of the first elastic piece interacts with the first push beam, and an unlocking process is a process in which a deformation amount of the first elastic piece increases.

[0022] Optionally, the locking mechanism further includes a second limiting portion, and the second limiting portion is fixed in the end accommodation cavity. The first lock body further includes a second limiting end, and in the locked state, the second limiting end abuts against the second limiting portion from bottom to top.

[0023] Optionally, the locking mechanism includes: a lock head, wherein the lock head is rotatably connected to the end connecting hook, and the lock head is provided with a locking portion and a support portion at two sides of its rotational center line respectively; a second lock body, wherein the second lock body is slidably connected to the end connecting hook; and a second locking and driving assembly in transmission connection with the second lock body. In a locked state, the second lock body supports the support portion from bottom to top, so that the locking portion presses the holding part; in an unlocked state, the second locking and driving assembly may drive the second lock body to displace in a direction away from the lock head, and the support portion may rotate downward around the rotational center line, so that the locking portion may rotate upward to be separated from the holding part.

[0024] Optionally, the second locking and driving assembly includes a second push beam, a second guide sleeve and

a connecting beam unit. The second guide sleeve is fixed in the end accommodation cavity, and the second push beam is slidably connected to the second guide sleeve. One end of the connecting beam unit is hinged with the second push beam, and another end is hinged with the second lock body.

[0025] Optionally, a second elastic piece is further provided, one end of the second elastic piece interacts with the second push beam, and an unlocking process is a process in which a deformation amount of the second elastic piece increases.

[0026] Optionally, the locking mechanism further includes a rotary support body, and the rotary support body is fixed to the end connecting hook. The rotary support body is provided with a rotary shaft portion, the rotary shaft portion has an arc-shaped cylindrical surface, the lock head is provided with an arc-shaped notch that matches the rotary shaft portion, the lock head is inserted into the rotary shaft portion through the arc-shaped notch, and a central axis of the rotary shaft portion may serve as the rotational center line of the lock head.

[0027] Optionally, a center of gravity of the lock head deviates from the rotational center line in the longitudinal direction and is located at a side where the support portion is located; and/or, the vehicle body of the piggyback vehicle further includes a third elastic piece, and a locking process is a process in which a deformation amount of the third elastic piece increases.

[0028] Optionally, the transverse stop mechanism includes: a support seat, wherein the support seat is fixed to the end connecting hook, and the support seat is provided with a through hole; a first stop beam; and a stopping and driving beam assembly which is in transmission connection with the first stop beam. In a stopping state, the first stop beam extends out of the through hole to stop the holding part in the transverse direction; in an unblocking state, the stopping and driving beam assembly may drive the first stop beam to retract, to release the stopping of the holding part.

[0029] Optionally, a fourth elastic piece is further provided, the fourth elastic piece acts on the first stop beam, and an unblocking process is a process in which a deformation amount of the elastic piece increases.

[0030] Optionally, the stopping and driving beam assembly includes a first connecting beam which is hingedly arranged. One end of the first connecting beam is a first stopping and driving end, and another end is a connecting end. The first connecting beam is fixedly arranged with a first hinge shaft and is located between the first stopping and driving end and the connecting end. The connecting end is in transmission connection with the first stop beam.

[0031] Optionally, the transverse stop mechanism includes: a second stop beam which is hingedly arranged and a limiting beam, wherein two ends of the second stop beam are a second stopping and driving end and a stop end respectively, a hinge shaft of the second stop beam is located between the second stopping and driving end and the stop end, and the hinge shaft is fixed to the end connecting hook; and a limiting beam, wherein the limiting beam is fixed to the end connecting hook. In a stopping state, the limiting beam abuts against an outer side of the second stop beam in the transverse direction, and the second stop beam is used to stop the holding part in the transverse direction; in an unblocking state, the second stopping and driving end may rotate under a force, so as to drive the stop end to release the stopping of the holding part.

[0032] Optionally, the transverse stop mechanism further includes a first limiting member and a second limiting member, and the first limiting member and the second limiting member are both fixed to the end connecting hook. In an unblocking state, the second stop beam abuts against the first limiting member; in a stopping state, the second stop beam abuts against the second limiting member.

[0033] Optionally, the end connecting hook further includes an end hook wall plate covering an outer hook face of the end hook body. The end hook wall plate is provided with an end first connecting hole, the end first connecting hole is in communication with the end accommodation cavity, to allow an unlocking member to be able to extend into the end accommodation cavity through the end first connecting hole to unlock the locking mechanism.

[0034] Optionally, a brake pipe protective device is further provided. The brake pipe protective device includes: a protective housing, wherein a housing cavity of the protective housing is used for accommodating a brake pipe, and the protective housing is located at a transversely outer side of the holding part when the holding part and the body part of the piggyback vehicle are connected; and a protective connecting member having a protective inner end located at a lower side of the holding part, a protective outer end located at a transversely outer side of the protective inner end, and a protective adapting portion located between the protective inner end and the protective outer end. The protective inner end abuts against the holding part, the protective outer end is fixedly connected to the protective housing, the protective adapting portion is rotatably connected with the body part, so that during a process of separating the holding part and the body part, the protective connecting member may rotate under gravity to drive the protective housing to rotate outward; and in a process of connecting the holding part and the body part, the protective connecting member may rotate under pressing of the holding part to drive the protective housing to be reset to the transversely outer side of the holding part.

[0035] Optionally, the protective connecting member includes a first pivotedly connected plate, a second pivotedly connected plate and a pivoting shaft. The first pivotedly connected plate and the second pivotedly connected plate are spaced apart in a longitudinal direction, and the second pivotedly connected plate is closer to the holding part than the first pivotedly connected plate; the pivoting shaft passes through the first pivotedly connected plate, the body part and

the second pivotedly connected plate in sequence to connect the three together.

[0036] Optionally, the protective connecting member further includes a protective roller, and the protective roller is rotatably connected to the second pivotedly connected plate. The second pivotedly connected plate extends to the lower side of the holding part, to make an outer peripheral surface of the protective roller abuts against a lower surface of the holding part.

[0037] Optionally, the brake pipe protective device further includes a first protective limiting member, and the first protective limiting member is fixed to the body part. When that the protective housing rotates downward and outward to reach an extreme position, the protective connecting member abuts against the first protective limiting member.

[0038] Optionally, the brake pipe protective device further includes a magnetic member, and when the protective housing is located at the transversely outer side of the holding part, the protective housing is magnetically attracted to the holding part via the magnetic member.

[0039] Optionally, the body part includes two end underframes, a bogie is provided under each of the two end underframes, and each of the two end underframes is provided with the end connecting mechanism, the number of the holding part is one, and the holding part is mounted between the two end underframes. Or, the body part includes two end underframes and a joint underframe, the joint underframe includes two joint underframe sub-portions, the two joint underframe sub-portions are connected by a joint and are located between the two end underframes; a bogie is provided under each of the two end underframes, and the two joint underframe sub-portions share another bogie underneath, and the number of the holding part is two, each of the two holding parts is mounted between the corresponding end underframe and the corresponding joint underframe sub-portion which are adjacent to each other.

[0040] A piggyback vehicle is further provided according to the present application, including a vehicle body, which is the vehicle body of the piggyback vehicle according to the above solutions.

[0041] Since the vehicle body of the piggyback vehicle has the above technical effects, the piggyback vehicle having the vehicle body also has similar technical effects, which will not be described in detail here.

BRIEF DESCRIPTION OF THE DRAWINGS

[0042]

Figure 1 is a schematic view showing the structure of a vehicle body of a piggyback vehicle according to a specific embodiment of the present application;

Figure 2 is a schematic view showing the structure of a holding part;

Figure 3 is an exploded view of Figure 2;

Figure 4 is a partially enlarged view showing an upper hook in Figure 3;

Figure 5 is a front view of Figure 4;

Figure 6 is a partially enlarged view of a portion A in Figure 3;

Figure 7 is a partially enlarged view of a portion B in Figure 3;

Figure 8 is a schematic view showing the structure of an end wall body;

Figure 9 is a schematic structural view of Figure 8 from another perspective;

Figure 10 is a structural view showing that an intermediate wall body and an inclined wall body are connected;

Figure 11 is a schematic structural view of Figure 10 from another perspective;

Figure 12 is a structural view showing that two end underframes are mounted on bogies and connected to each other;

Figure 13 is a view showing the structure of an end underframe body and an end connecting mechanism;

Figure 14 is a side view showing that the structure in Figure 13 is mounted on the bogie and connected to the holding part;

Figure 15 is an exploded view of Figure 13;

Figure 16 is an enlarged view of an end longitudinal support member in Figure 13;

Figure 17 is an enlarged view of an end transverse limiting member in Figure 13;

Figure 18 is an enlarged view of a first assembly in Figure 13;

Figure 19 is an enlarged view of a second assembly in Figure 13;

Figure 20 is an enlarged view of a third assembly in Figure 13.

Figure 21 is an enlarged view of a third longitudinal beam and a fourth longitudinal beam in Figure 13;

Figure 22 is an enlarged view of a first bolster and a second bolster in Figure 13;

Figure 23 is an enlarged view of an end side bearing in Figure 13;

Figure 24 is an enlarged view of a container lock seat in Figure 13;

Figure 25 is an enlarged view of a set of reinforcing plates in Figure 13;

Figure 26 is a view showing the structure of a joint underframe;

Figure 27 is a side view in which the joint underframe in Figure 26 is mounted on the bogie and connected with the holding part;

Figure 28 is a view showing the structure of a joint underframe sub-portion of Figure 26;

Figure 29 is a view showing Figure 28 from another perspective;

Figure 30 is a view showing the structure of another joint underframe sub-portion in Figure 26;

Figure 31 is an exploded view of Figure 28;

Figure 32 is an enlarged view of a joint longitudinal support member in Figure 31;

Figure 33 is an enlarged view of a joint transverse limiting member in Figure 31;

Figure 34 is an enlarged view of a first assembly in Figure 31;

Figure 35 is an enlarged view of a second joint cross beam and a third joint cross beam in Figure 31;

Figure 36 is an enlarged view of a joint side bearing in Figure 31;

Figure 37 is an enlarged view of a set of reinforcing plates in Figure 31;

Figure 38 is a structural view showing that the first type of locking mechanism is mounted on an end connecting hook;

Figure 39 is a structural view showing the end connecting hook, the holding part and the first type of locking mechanism in a locked state;

Figure 40 is a side view of Figure 39;

Figure 41 is a side view of Figure 39 in an unlocked state;

Figure 42 is a structural view showing that a first lock body and a first locking and driving beam assembly are connected;

Figure 43 is an exploded view of Figure 42;

Figure 44 is a structural view showing that a first limiting portion, a second limiting portion and a first guide sleeve are fixed to the end connecting hook;

Figure 45 is a structural view showing that a second type of locking mechanism is mounted on the end connecting hook;

Figure 46 is a structural view showing the end connecting hook, the holding part and the second type of locking mechanism in a locked state;

Figure 47 is a structural view showing the end connecting hook, the holding part and the second locking mechanism in an unlocked state;

Figure 48 is a structural view showing that a second guide sleeve, a fourth limiting portion, and a rotary support body are fixed to the end connecting hook;

Figure 49 is a structural view showing that a second push beam is connected with a connecting beam unit and a second lock body;

Figure 50 is a schematic view showing the structure of a second connecting sleeve;

Figure 51 is a schematic view showing the structure of an adapting block;

Figure 52 is a schematic view showing the structure of a lock head;

Figure 53 is a schematic view showing the structure of the second lock body;

Figure 54 is a schematic view showing the structure of the rotary support body;

Figure 55 is a structural view showing that a first type of transverse stop mechanism is mounted on the end connecting hook;

Figure 56 is a structural view showing a specific embodiment of the first type of transverse stop mechanism;

Figure 57 is an exploded view of Figure 56;

Figure 58 is a structural view showing a support seat;

Figure 59 is an exploded view of the first connecting beam;

Figure 60 is a structural view showing another specific embodiment of the first type of transverse stop mechanism;

Figure 61 is an exploded view of a connection structure between a first stop beam and a connecting end in Figure 60;

Figure 62 is a view showing relative positions among the second type of transverse stop mechanism, the end connecting hook, and the holding part in a stopping state;

Figure 63 is a partially enlarged view of Figure 62;

Figure 64 is a view showing relative positions among the second type of transverse stop mechanism, the end connecting hook, and the holding part in an unblocking state;

Figure 65 is a partially enlarged view of Figure 64;

Figure 66 is a structural view showing that the second type of transverse stop mechanism is mounted on the end connecting hook;

Figure 67 is an exploded view of Figure 66;

Figure 68 is a view showing the structure of a brake pipe protective device;

Figure 69 is an enlarged view showing a portion C in Figure 68;

Figure 70 is an enlarged view showing a portion D in Figure 68;

Figure 71 is an enlarged view showing a portion E in Figure 68;

Figure 72 is a structural view showing the brake pipe protective device in a state where the holding part and the body part are connected;

Figure 73 is an enlarged view of a portion inside a circle indicated in Figure 72;

Figure 74 is a structural view showing the brake pipe protective device in a state where the holding part and the body part are separated;

Figure 75 is an enlarged view of a portion inside a circle indicated in Figure 74;

Figure 76 is a structural view showing that a first protective limiting member and a second protective limiting member are arranged on the support seat;

Figure 77 is a view showing the structure of a first pivotedly connected plate;

Figure 78 is a view showing the structure of a second pivotedly connected plate;

Figure 79 is a view showing the structure of a protective partition;

Figure 80 is a view showing the structure of a pipe hanger seat plate; and

Figure 81 is a view showing the structure of a pipe hanger connecting plate.

[0043] Reference numerals in the drawings are listed as follows:

1	body part;		
2	end underframe,	21	end underframe body,
2101	first cross beam,	2102	second cross beam,
2103	first longitudinal beam,	2104	second longitudinal beam,
2105	third longitudinal beam,	2106	fourth longitudinal beam,
2107	first bolster,	2108	second bolster,
2109	end traction beam,	2110	impact seat,
2111	container lock seat,	2112	end side bearing,
2113	reinforcing plate,	2114	saddle mounting seat,
2115	buffer mounting seat,	22	end connecting mechanism,
221	end connecting hook,	221a	end groove,
221b	end hook body,	221b-1	end hook sub-body,
221b-2	end accommodation cavity,	221c	end hook wall plate,
221d	end first connecting hole,	221e	end second connecting hole,
222	end longitudinal support member,		
222a	end longitudinal support body,		
222b	end wear plate,	223	end transverse limiting member,
223a	end transverse limiting groove,		
223b	left guide face,	223c	right guide face;
3	joint underframe,	3a	joint underframe sub-portion,

(continued)

31	joint underframe body,	3101	first joint cross beam,
3102	second joint cross beam,	3103	third joint cross beam,
3104	first joint longitudinal beam,	3105	second joint longitudinal beam,
3106	joint traction beam,	3107	first joint floor,
3108	second joint floor,	3109	joint side bearing,
3110	reinforcing plate,	32	joint connecting mechanism,
321	end connecting hook,	321a	end groove,
321b	joint hook body,	321b-1	joint hook sub-body,
321b-2	joint accommodation cavity,	321c	joint hook wall plate,
321d	joint first connecting hole,	321e	joint second connecting hole,
322	joint longitudinal support member,		
322a	joint longitudinal support body,		
322b	joint wear plate,	323	end transverse limiting member,
323a	joint transverse limiting groove,		
323b	left guide face,	323c	right guide face,
33	joint,	34	joint bearing;
4	holding part,	41	bottom wall,
411	intermediate wall body,	411a	longitudinal beam,
411a-1	flat beam section,	411a-1a	flat plate,
411a-1b	reinforcing beam,	411a-2	grid beam section,
411a-2a	small crossbar,	411a-2b	connecting plate,
411b	transverse beam,		
411b-1	rotation center insertion connection portion,		
411b-2	longitudinal positioning block,		
412	end wall body,	412a	main body portion,
412a-1	connection mounting position,		
412b	connecting portion,	412b-1	vertical plate portion,
412b-2	side plate portion,	412b-3	inclined plate portion,
412c	lower circular shaft,	412d	pressing plate,
413	inclined wall body,	42	side wall,
421	upper hook,	421a	top face section,
421b	side face section,	421c	wear plate,
422	guide limiting member,	423	reinforcing structure,
423a	intermediate vertical plate,	423b	end vertical plate,
423c	outer side plate,	423d	inner side plate,
423e	notch slot;		
5	locking mechanism,	51	first lock body,
511	locking end,	512	first limiting end,
513	mounting groove,	514	second limiting end,
52	third hinge shaft,	521	locking mounting plate,
522	bolt,	53	first limiting portion,
54	first locking and driving beam assembly,		
541	first push beam,	541a	first connecting sleeve,
541b	first elastic piece,	541c	first support member,
542	first guide sleeve,	543	transmission beam,
55	second limiting portion;		
51’	lock head,	511’	locking portion,
512’	support portion,	513’	arc-shaped notch,
514’	support groove,	52’	second lock body,
521’	insertion section,	522’	slide groove,
523’	large-sized support section,	524’	small-sized support section,

(continued)

53’	second locking and driving beam assembly,		
531’	second push beam,	531a’	second connecting sleeve,
531b’	second elastic piece,	531c’	second support member,
532’	second guide sleeve,	533’	connecting beam unit,
533a’	first locking connecting beam,		
533b’	second locking connecting beam,		
533c’	adapting block,	533c-1’	fixed hinge point,
533c-2’	first hinge point,	533c-3’	second hinge point,
54’	rotary support body,	541’	rotary shaft portion,
542’	third limiting portion,	543’	slide rail,
55’	fourth limiting portion;		
6	transverse stop mechanism,	61	support seat,
611	through hole,	612	mounting hole,
613	stop connecting plate,	614	guard plate,
615	stop upper cover plate,	62	first stop beam,
621	thick neck portion,	622	thin neck portion,
623	stepped face,	624	first anti-loose member,
63	stopping and driving beam assembly,		
631	first connecting beam,	6311	first drive end,
6312	connecting end,	631a	long plate,
631a-1	strip-shaped guide hole,	631b	short plate,
613b-1	through hole,	631c	roller,
631d	roller shaft,	631d-1	rod portion,
631d-2	head,	631d-3	locking nut,
631e	strip-shaped guide groove,	631f	locking member,
631g	first gasket,	632	second connecting beam,
633	first hinge shaft,	633a	mounting plate,
634	second hinge shaft,	64	third elastic piece,
65	stop limiting member;		
61’	second stop beam,	611’	drive end,
612’	stop end,	613’	hinge shaft,
613a’	large diameter section,	613b’	small diameter section,
613c’	third limiting member,	613d’	second gasket,
62’	limiting beam,	63’	first limiting member,
64’	second limiting member,	65’	fourth elastic piece;
10	brake pipe protective device,	11	protective housing,
111	C-shaped protective beam,	112	protective blocking plate,
113	pipe hanger assembly,	1131	protective partition,
1132	pipe hanger seat plate,	1133	pipe hanger connecting plate,
12	protective connecting member,		
12a	protective inner end,	12b	protective outer end,
12c	protective adapting portion,	12d	protective through hole,
121	first pivotedly connected plate,		
122	second pivotedly connected plate,		
123	pivoting shaft,	1231	limiting pin,
124	fixed shaft,	125	protective roller,
13	first protective limiting member,		
14	magnetic member,	15	second protective limiting member;
20	brake pipe,	201	flange connector.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0044] For those skilled in the art to better understand technical solutions of the present application, the present application will be described in detail in conjunction with the drawings and specific embodiments hereinafter.

[0045] In this application, a longitudinal direction of a piggyback vehicle is taken as the longitudinal direction, and the longitudinal direction also refers to a front-rear direction. In a travel plane of a railway vehicle, a direction perpendicular to the longitudinal direction is a transverse direction, and the transverse direction also refers to a left-right direction. In the transverse direction, a position relatively close to a center of a railway track in the transverse direction is referrerd to as "inner", and a position relatively away from the transverse center of the railway track in the transverse direction is referred to as "outer". A direction perpendicular to the above travel plane is a vertical direction, wherein a direction relatively away from the ground is "up", and a direction relatively close to the ground is "down".

[0046] In this application, "first", "second", "third" and other similar indicating words are only used for distinguishing and describing, and cannot be understood as indicating or implying relative importance or representing an order relationship.

[0047] Referring to Figure 1, Figure 1 is a schematic view showing a vehicle body of a piggyback vehicle according to a specific embodiment of the present application.

[0048] As shown in Figure 1, a vehicle body of a piggyback vehicle is provided according to the present application, which includes a body part 1 and a holding part 4, and each of two longitudinal ends of the holding part 4 is provided with a connection structure. The connection structure includes an upper hook 421 and a lower circular shaft 412c extending in a transverse direction. An end connecting mechanism 22 is provided on the body part 1. The end connecting mechanism 22 includes an end connecting hook 221 and an end longitudinal support member 222. An upward hook opening is defined by the end connecting hook 221. In an assembled state, the lower circular shaft 412c can be hung on the hook opening of the end connecting hook 221, and the upper hook 421 can be clamped onto the end longitudinal support member 222.

[0049] With this structure, two connection points, one formed between the upper hook 421 and the end longitudinal support member 222 and the other formed between the lower circular shaft 412c and the end connecting hook 221, are provided between each of the two longitudinal ends of the holding part 4 and the body part 1, thus the connection between the holding part 4 and the body part 1 is more reliable. Besides, during separation, by lifting the body part 1, the body part 1 and the holding part 4 may rotate with respect to each other by taking a central axis of the lower circular shaft 412c as a rotational center line, forcing a junction between the upper hook 421 and the end longitudinal connecting member 222 to become loose, thus facilitating the separation of the holding part 4 and the body part 1.

[0050] Embodiments of the present application will be described hereinafter, in which structures of different components of the vehicle body of the piggyback vehicle according to the present application will be described respectively.

Holding part 4

[0051] Please refer to Figure 2 to Figure 11, Figure 2 is a schematic view showing the structure of the holding part, Figure 3 is an exploded view of Figure 2, Figure 4 is a partially enlarged view showing the upper hook in Figure 3, Figure 5 is a front view of Figure 4, Figure 6 is a partially enlarged view of a portion A in Figure 3, Figure 7 is a partial enlarged view of B in Figure 3, Figure 8 is a schematic view showing the structure of an end wall, Figure 9 is a schematic structural view of Figure 8 from another perspective, Figure 10 is a structural view showing that an intermediate wall body and an inclined wall body are connected, and Figure 11 is a schematic structural view of Figure 10 from another perspective.

[0052] With reference to Figure 2, and in conjunction with Figure 4 and Figure 5, a clamping face, where the upper hook 421 is clamped to the end longitudinal support member 222, of the upper hook 421 may include a top face section 421a and two side face sections 421b, to form a U-shaped clamping face with an opening facing downward. In the two side face sections 421b, a first side face section may be a vertical face, and a second side face section may be an inclined face which is inclined from top to bottom in a direction away from the first side face section. Or, each one of the two side face sections 421b may be an inclined face which is inclined from top to bottom in a direction away from the other one.

[0053] In this way, a tapered clamping opening that gradually shrinks from bottom to top is formed by the clamping face. The tapered clamping opening in this form may facilitate the clamping connection between the upper hook 421 and the end longitudinal support member 222, and the clamping effect may be enhanced as the holding part 4 and the body part 1 are getting closer to each other, which may form the connection characteristics that the connection becomes tighter as the body part being lowered. Moreover, since a lower portion of the tapered clamping opening is relatively large, once the junction between the upper hook 421 and the end longitudinal support member 222 becomes loose, it is easier to separate the upper hook 421 and the end longitudinal support member 222 from each other.

[0054] It should be noted that the solution of the tapered clamping opening is only a preferred solution of the embodiments of the present application, and cannot be used to limit the scope of implementation of the vehicle body of the

piggyback vehicle according to the present application. In specific implementation, the two side face sections 421b may both be arranged as vertical faces, which may also achieve the technical effects of the clamping connection with the body part.

[0055] During the mounting and separation processes of the holding part 4 and the body part, there is friction in the form of sliding friction and static friction between the clamping face of the upper hook 421 and the body part, which may cause wear to the upper hook 421. For this reason, each of the two side face sections 421b is provided with a holding part wear plate 421c, so that the wear may occur on the holding part wear plate 421c rather than directly occur on the upper hook 421, which has a positive effect on improving the service life of the holding part 4.

[0056] With continued reference to Figure 5, the holding part wear plate 421c may be connected to the corresponding side face section 421b by a connecting piece such as a screw or the like. In the processes of mounting, separation and use of the holding part 4, a direction of a friction force subjected by the holding part wear plate 421c is perpendicular to an axial direction of the above connecting piece, which may cause each connecting piece to be subjected to an unnecessary shear force. In a situation of long-term use, this shearing force may seriously affect the connection reliability of the holding part wear plate 421c. In fact, even if the holding part wear plate 421c is fixed by welding, the welding seam may be subjected to the above shearing force.

[0057] In view of this, in the embodiment of the present application, a shear-resisting stop structure may be provided between the holding part wear plate 421c and the side face section 421b, so as to offset the friction force subjected by the holding part wear plate 421c through the shear-resisting stop structure. In this way, each connecting piece (or welding seam) may substantially be in a state of being subjected to no forces in the perpendicular direction, and thus the connection reliability is higher.

[0058] In detail, the shear-resisting stop structure may be arranged at the holding part wear plate 421c, for example, the holding part wear plate 421c located on a left side in Figure 5. The holding part wear plate 421c may substantially be of an L shape, and a transverse portion of the L shape may abut against the side face section 421b. In this way, the friction force acting on the holding part wear plate 421c may act on the upper hook 421 via the transverse portion, thus eliminating the shearing force. Or, the shear-resisting stop structure may be provided at the side face section 421b, for example, the side face section 421b on a right side in Figure 5, the side face section 421b may be provided with a notch, and the holding part wear plate 421c may be mounted in the notch and abut against a top wall of the notch, so that an acting force between the holding part wear plate and the top wall may offset the friction force subjected by the holding part wear plate 421c, and finally the shearing force is eliminated.

[0059] With reference to Figure 3, the holding part 4 may include a bottom wall 41 and two side walls 42 connected to the bottom wall 41, and each of two longitudinal ends of the two side walls 42 is provided with the upper hook 421.

[0060] Moreover, the side wall 42 may further be provided with a guide limiting member 422, the guide limiting member 422 may be specifically arranged at the upper hook 421, and may be plate-shaped, block-shaped, column-shaped, etc.. The guide limiting member 422 is mainly used to cooperate with a limiting guide member of the body part 1 (the specific structure please refer to the description of the body part 1 hereinafter), to guide the mounting of the holding part 4 and limit the holding part 4 in the transverse direction.

[0061] For example, the limiting guide member of the main body 1 may be provided with a limiting guide groove, from bottom to top, the limiting guiding groove may include a constant width groove section and a varied width groove section. The width here refers to a transverse dimension. A width of the constant width groove section may be substantially the same as a width of the guide limiting member 422, while a width of the varied width groove section may gradually increase from bottom to top. In this way, through the cooperation between the guide limiting member 422 and the varied width groove section, the mounting of the holding part 4 can be guided to ensure the accuracy of the mounting position of the holding part 4. When the guide limiting member 422 is inserted into the constant width groove section, the holding part 4 can be limited in the transverse direction by the cooperation between the guide limiting member 422 and the constant width groove section may limit.

[0062] An outer side surface of the side wall 42 may be provided with a reinforcing structure 423 to improve the strength of the side wall 42. The reinforcing structure 423 may specifically be a reinforcing member in the form of a reinforcing rib, a reinforcing plate, etc. Or, when the vehicle body of the piggyback vehicle according to the present application is used to transport containers, the reinforcing structure 423 may be a mounting position for a container lock. In this way, there's no need to specially provide the reinforcing structure 423, which is beneficial to simplify the structure of the side wall 42.

[0063] With reference to Figure 6 and Figure 7, in an exemplary solution, to arrange the mounting position for the container lock, an upper cover plate of the side wall 42 may be modified first, an outer side of the upper cover plate may be provided with a notch slot 423e, corresponding to the position of the notch slot 423e, an inner side plate 423d and an outer side plate 423c may be provided at the inner and outer sides respectively, and an intermediate vertical plate 423a and an end vertical plate 423b both for connecting the inner side plate 423d and the outer side plate 423c are also provided. This type of mounting position has an obvious reinforcing effect on the side wall 42, which may replace traditional reinforcing ribs, reinforcing plates and other types of reinforcing members.

[0064] It may be understood that the above description of the specific structure of the mounting position for the container lock is only an exemplary description of the mounting position for a specific container lock, which does not represent mounting positions for all forms of container locks. In the specific implementation, if the structure of the required container lock is changed, the structure of the above mounting position may be adjusted adaptively, which may be referred to the conventional technology, and will not be described in detail here.

[0065] The bottom wall 41 may include an intermediate wall body 411 and an end wall body 412 located at each of two longitudinal sides of the intermediate wall body 411. As shown in Figure 8 and Figure 9, the end wall body 412 may include a main body portion 412a and a connecting portion 412b, wherein the connecting portion 412b may be used to connect the main body portion 412a and the side wall 42. In the process of loading and unloading, because a road vehicle constantly drives on and off, wheels of the road vehicle will frequently run over the main body portion 412a. In order to improve the strength and service life of the main body portion 412a, the main body portion 412a may employ a box structure, which may ensure the strength on one hand, and reduce the weight on the other hand. The lower circular shaft 412c may be mounted at an end of the main body portion 412a away from the intermediate wall body 411.

[0066] The connecting portion 412b may be a C-shaped plate including a vertical plate portion 412b-1 and a side plate portion 412b-2. In this way, the strength of the connecting portion 412b itself may be higher, and the reliability of the connection between the main body portion 412a and the side wall 42 is greatly ensured. Moreover, the side plate portion 412b-2 may further include an inclined plate portion 412b-3 gradually inclined upward from inside to outside. With reference to Figure 8, this form of inclined plate portion 412b-3 may guide the wheels of the road vehicle to ensure that the wheels of the road vehicle roll on the main body portion 412a as much as possible.

[0067] Each of two transverse sides of the main body portion 412a may further be provided with a pressing plate 412d, which may serve as a driving member when the holding part 4 falls down and is mounted at the body part, to drive a brake pipe protective device (not shown in the figure) to rotate back.

[0068] As shown in Figure 10 and Figure 11, the intermediate wall body 411 may include two longitudinal beams 411a spaced apart in the transverse direction, and the two longitudinal beams 411a may be connected by multiple transverse beams 411b spaced apart in the longitudinal direction. Since the weight of the road vehicle is transmitted mainly through the wheels at both sides of the transverse direction, the intermediate wall body 411 with the above structure may bear the gravity transmitted by the wheels at both sides of the transverse direction through the two longitudinal beams 411a spaced apart in the transverse direction. A transversely intermediate area, which is a portion that does not need to be in direct contact with the wheels, may adopt a hollowed structure formed by multiple transverse beams 411b spaced apart, which has a positive effect on reducing the weight of the intermediate wall body 411.

[0069] Of course, the intermediate wall body 411 may also be an integrated wall, which does not affect its function of bearing road vehicles.

[0070] Each of the longitudinal beams 411a may include a flat beam section 411a-1 and a grid beam section 411a-2. The flat beam section 411a-1 may include a flat plate 411a-1a and multiple reinforcing beams 411a-1b mounted at a bottom of the flat plate 411a-1a. There are various structural forms of the reinforcing beams 411a-1b, the solution shown in the figure is a combination of transversely and longitudinally staggered beams. Of course, other structures may also be used, as long as the technical effect of strengthening the flat plate 411a-1a can be achieved. The grid beam section 411a-2 may include multiple small crossbars 411a-2a spaced apart in the longitudinal direction. Each two small crossbars 411a-2a adjacent to each other along the longitudinal direction may be connected by a connecting plate 411a-2b.

[0071] With this arrangement, there is a gap between each two adjacent small crossbars 411a-2a of the grid beam section 411a-2, which may facilitate mounting a shield for limiting the wheels of the road vehicles. The flat beam section 411a-1 may serve as a parking position for a support leg of a semi-trailer, so as to cooperate with a bottom plate of the support leg, thereby reliably supporting the support leg of the semi-trailer.

[0072] It should be noted that, in the embodiment of the present application, proportions of the longitudinal beams 411a and the transverse beams 411b in the transverse direction of the intermediate wall body 411 are not limited, and proportions of the flat beam section 411a-1 and the grid beam section 411a-2 in the longitudinal direction of the longitudinal beam 411a are not limited either. In specific implementation, it may be arranged by those skilled in the art according to actual needs.

[0073] The intermediate wall body 411 may further be provided with a longitudinal positioning structure. Specifically, the longitudinal positioning structure may include a longitudinal positioning block 411b-2, and may be mounted on the transverse beam 411b. The longitudinal positioning block 411b-2 may be provided with a positioning opening which is V-shaped or of other shapes. When the piggyback vehicle arrives at a designated station for parking, a positioning device on the ground can interact with the positioning opening to accurately position the longitudinal position of the piggyback vehicle, which is more convenient for the mounting and separation of the holding part 4.

[0074] There are mainly two solutions for mounting and separation between the holding part 4 and the body part, namely, rotation and translation. For the solution of rotation, the holding part 4 is required to be further provided with a rotation center insertion connection portion 411b-1.

[0075] The rotation center insertion connection portion 411b-1 may specifically be of a hole type or a groove type, and its mounting position may be on the transverse beam 411b. When the piggyback vehicle arrives at the designated station, a device on the ground may provide a rotating pin by the manner of lifting or the like, and the rotating pin is inserted into the rotation center insertion connection portion 411b-1, thus serving as a rotation center of the holding part 4. For the solution of translation, connection mounting positions 412a-1 may be provided on a bottom surface of the holding part 4 for the translation of the driving member. The connection mounting position 412a-1 may also be of a hole type or a groove type. In Figure 9, the connection mounting positions 412a-1 may be provided on a bottom surface of the end wall body 412.

[0076] The bottom wall 41 may further include an inclined wall body 413 that gradually inclined upward from inside to outside. The inclined wall body 413 is located at each of two transverse sides of the intermediate wall body 411 and is used to connect the intermediate wall body 411 and the side wall 42. The function of the inclined wall body 413 is similar to the inclined plate portion 412b-3, which may be used to guide the wheels of the road vehicle, to ensure that the wheels of the road vehicle stay on the two longitudinal beams 411a as much as possible. According to the solution in the drawings, two longitudinal ends of the inclined wall body 413 may be connected to the inclined plate portion 412b-3.

BODY PART 1

[0077] Based on the holding part 4 according to the above solutions, the structure of the body part 1 of the vehicle body of the piggyback vehicle provided by the present application is actually not limited, as long as the end connecting mechanism 22 is provided to cooperate with the connection structure at each of the two longitudinal ends of the holding part 4.

[0078] In the embodiments of the present application, the vehicle body may be classified into the following two forms according to the number of holding parts 4 in each vehicle body.

[0079] First, as shown in Figure 1, the number of the holding part 4 may be one, and the body part 1 may include two end underframes 2. A bogie may be arranged under each of the two end underframes 2, each of the two end underframes 2 may be provided with the end connecting mechanism 22, and the holding part 4 may be mounted between the two end underframes 2.

[0080] Second, the number of the holding parts 4 may be multiple, and the number of the holding parts 4 is generally no more than two due to the limitation of the weight of the shafts. Taking the case that the number is two as an example, the body part 1 may include two end underframes 2 and a joint underframe 3. The joint underframe 3 may include two joint underframe sub-portions 3a, and the two joint underframe sub-portions 3a may be connected by a joint and are located between the two end underframes 2. A bogie is provided under each of the two end underframes 2, and the two joint underframe sub-portions 3a may share another bogie underneath. Each of the two holding parts 4 may be mounted between the corresponding end underframe 2 and the corresponding joint underframe sub-portion 3a which are adjacent to each other. In this way, the longitudinal length of each vehicle body can be more fully utilized, which increases the cargo capacity of the vehicle body, thereby effectively reducing the transportation cost.

[0081] The end underframe 2 may include the end connecting mechanism 22, and the specific structure may be referred to Figures 12-25. Figure 12 is a structural view showing that the two end underframes are mounted on the bogies and connected to each other; Figure 13 is a view showing the structure of an end underframe body and the end connecting mechanism; Figure 14 is a side view showing that the structure in Figure 13 is mounted on the bogie and connected to the holding part; Figure 15 is an exploded view of Figure 13; Figure 16 is an enlarged view of the end longitudinal support member in Figure 13; Figure 17 is an enlarged view of an end transverse limiting member in Figure 13; Figure 18 is an enlarged view of a first assembly in Figure 13; Figure 19 is an enlarged view of a second assembly in Figure 13; Figure 20 is an enlarged view of a third assembly in Figure 13; Figure 21 is an enlarged view of a third longitudinal beam and a fourth longitudinal beam in Figure 13; Figure 22 is an enlarged view of a first bolster and a second bolster in Figure 13; Figure 23 is an enlarged view of an end side bearing in Figure 13; Figure 24 is an enlarged view of a container lock seat in Figure 13; and Figure 25 is an enlarged view of a set of reinforcing plates in Figure 13.

[0082] As shown in Figure 12, when there are multiple vehicle bodies, two adjacent vehicle bodies may be connected by two end underframes 2. In the figure, the two end underframes 2 are connected by a coupler. In addition, the bogie is provided under each of the end underframes 2. In other words, each of the end underframes 2 is mounted on the corresponding bogie.

[0083] With reference to Figure 13, the end connecting mechanism 22 is connected to a rear end of the end underframe body 21. The definitions of front and rear are mainly determined in accordance with the perspective in the drawings. In fact, since each of the vehicle bodies includes two end underframes 2 arranged symmetrically with respect to each other, front, rear, left and right positions of the two end underframes 2 are actually opposite, which may be understood in conjunction with annotations of front, rear, left, and right in Figure 12.

[0084] The end connecting mechanism 22 includes the end connecting hook 221. The hook opening of the end connecting hook 221 faces upward. An inner hook face of the end connecting hook 221 is provided with an end groove

221a extending in the transverse direction.

[0085] As shown in Figure 14, in the connected state, the lower circular shaft 412c of the holding part 4 is placed in the end groove 221a, and receives an upward supporting force from an inner surface of the end groove 221a, thus being effectively supported in a vertical direction. In addition, the inner surface of the end groove 221a may also longitudinally limit the lower circular shaft 412c to a certain extent. Therefore, the connection between the end underframe 2 and the holding part 4 is more reliable. Moreover, by applying an upward lifting force to the holding part 4, the lower circular shaft 412c can be released from the end groove 221a, which facilitates the separation of the end underframe 2 and the holding part 4.

[0086] Further, as shown in Figure 13, the end connecting mechanism 22 further includes the end longitudinal support member 222. The end longitudinal support member 222 is located above the end connecting hook 221, which specifically may be directly above or obliquely above.

[0087] As shown in Figure 16, the end longitudinal support member 222 includes an end longitudinal support body 222a and an end wear plate 222b fixed at each of a front end and a rear end of the end longitudinal support body 222a.

[0088] As shown in Figure 2, an end of the holding part 4 is provided with the upper hook 421, and a hook opening of the upper hook 421 faces downward.

[0089] As shown in Figure 14, in the connected state, the end longitudinal support body 222a extends into the hook opening of the upper hook 421, and the two are hooked together. At the same time, the end wear plate 222b located at the front end abuts against a front side of an inner hook face of the upper hook 421, and the end wear plate 222b located at the rear end abuts against a rear side of the inner hook face of the upper hook 421, thereby supporting the holding part 4 in the longitudinal direction. In this way, the reliability of the connection between the end underframe 2 and the holding part 4 may be further enhanced, and the convenience of separation of the end underframe 2 and the holding part 4 will not be affected.

[0090] As shown in Figure 16, an upper portion of the end wear plate 222b at the front end is inclined backward relative to a lower portion thereof, and an upper portion of the end wear plate 222b at the rear end is inclined forward relative to a lower portion thereof. Besides, the inner surface of the end groove 221a forms an end guide face, and the end guide face, when cooperating with the lower circular shaft 412c, may guide the falling of the holding part 4 during mounting. Moreover, the end guide face may also cooperate with the lower circular shaft 412c to guide the holding part 4 and the body part 1 to be separated from each other in a rotational manner.

[0091] Specifically, when the holding part 4 and the end underframe 2 are being connected, the end guide face may guide the lower circular shaft 412c to gradually slide into the end connecting hook 221, to guide the mounting of the holding part 4. And as the holding part 4 continues falling, the degree of clamping between the end longitudinal support body 222a and the upper hook 421 may be gradually increased, which is convenient for the upper hook 421 to firmly hook the end longitudinal support body 222a. When the holding part 4 and the end underframe 2 are being separated, an upward lifting force (force F in Figure 14) may be applied to a position of the end underframe 2 near a rear end thereof. When being lifted to a certain height, the end underframe 2 is guided by the inner surface of the end groove 221a to rotate counterclockwise by taking the central axis of the lower circular shaft 412c as the rotation center. Thus, the end longitudinal support body 222a may be released from the upper hook 421, which facilitates the separation between the end underframe 2 and the holding part 4. In short, such an arrangement improves reliability of connection and convenience of separation between the end underframe 2 and the holding part 4.

[0092] In the solution shown in the figure, a top of the end longitudinal support body 222a is a trapezoidal structure with a small upper portion and a large lower portion (see Figure 16), and the end wear plate 222b at the rear end is positioned lower in height than the end wear plate 222b at the front end. In this way, it is ensured that the end underframe 2 can smoothly rotate counterclockwise as described above without interference. Of course, the structure for avoiding interference is not limited to this, and may be adjusted reasonably in actual implementation. In Figure 16, the end wear plates 222b and the end longitudinal support body 222a are connected by bolts and nuts. The end longitudinal support body 222a is of a hollow structure, and a bottom thereof is provided with an oblong hole, which facilitates the replacement of the end wear plates 222b.

[0093] In the solution shown in the figure, the end groove 221a is a cylindrical groove (see Figure 13), so that the inner surface of the end groove 221a may play the above guiding function when cooperating with the cylindrical lower circular shaft 412c. Of course, in actual implementation, the end groove 221a is not limited to the cylindrical groove.

[0094] Further, as shown in Figure 13, the end connecting mechanism 22 further includes an end transverse limiting member 223. The end transverse limiting member 223 is a limiting guide member provided on the end underframe 2 and cooperating with the guide limiting member 422 of the holding part 4. The end transverse limiting member 223 is located above the end connecting hook 221, which specifically may be directly above or obliquely above. In addition, the end transverse limiting member 223 is located in front of the end longitudinal support member 222, which specifically may be directly in front of or obliquely in front of the end longitudinal support member 222.

[0095] As shown in Figure 17, the end transverse limiting member 223 includes an end transverse limiting groove 223a.

[0096] With reference to Figure 14, in the connected state, the guide limiting member 422 is inserted into the end

transverse limiting groove 223a. A left side groove wall and a right side groove wall of the end transverse limiting groove 223a are located at a left side and a right side of the guide limiting member 422, respectively, to limit the guide limiting member 422 in the transverse direction. In this way, the reliability of the connection between the end underframe 2 and the holding part 4 may be further improved.

[0097] In the solution shown in the figure, an upper portion of the left side groove wall and/or an upper portion of the right side groove wall of the end transverse limiting groove 223a may form a left guide face 223b and a right guide face 223c, respectively (see Figure 17). An upper side of the left guide face 223b is inclined leftward relative to a lower side thereof, and an upper side of the right guide face 223c is inclined rightward relative to a lower side thereof, so that the guide limiting member 422 may be guided into the end transverse limiting groove 223a.

[0098] In Figure 17, the end transverse limiting member 223 is composed of a U-shaped plate and two rib plates. In actual implementation, the structure of the end transverse limiting member 223 is not limited to this.

[0099] As shown in Figure 13 and Figure 15, the end underframe body 21 includes a first cross beam 2101, a second cross beam 2102, a first longitudinal beam 2103, a second longitudinal beam 2104, a third longitudinal beam 2105, a fourth longitudinal beam 2106, a first bolster 2107, a second bolster 2108, an end traction beam 2109, an impact seat 2110 and end side bearings 2112, a saddle mounting seat 2114 and a buffer mounting seat 2115 (see Figure 20).

[0100] As shown in Figure 13, the first cross beam 2101 is arranged in front of the second cross beam 2102, the first longitudinal beam 2103 and the second longitudinal beam 2104 are fixed at rear sides of both ends of the first cross beam 2101, respectively, the third longitudinal beam 2105 and the fourth longitudinal beam 2106 are fixed at front sides of both ends of the second cross beam 2102, respectively. A rear end of the first longitudinal beam 2103 and a front end of the third longitudinal beam 2105 are respectively fixed to a right end of the first bolster 2107, and a rear end of the second longitudinal beam 2104 and a front end of the fourth longitudinal beam 2106 are respectively fixed to a left end of the second bolster 2108, thus forming a frame. The end traction beam 2109 is located inside the frame, a front end of the end traction beam 2109 is fixed to the first cross beam 2101, and a rear end of the end traction beam 2109 is fixed to the second cross beam 2102. A left end of the first bolster 2107 and the left end of the second bolster 2108 are respectively fixed to left and right sides of the end traction beam 2109. The fixing manner between beams may be welding. The impact seat 2110 is fixed at a front side of the first cross beam 2101, which specifically may be fixed by riveting or bolting. The impact seat 2110 is connected to the coupler to withstand impact from the coupler. The end connecting mechanism 22 is fixed to the second cross beam 2102, which specifically may be fixed by welding. One end side bearing 2112 is fixed to the first bolster 2107, and another end side bearing 2112 is fixed to the second bolster 2108, which specifically may be fixed by welding.

[0101] As shown in Figure 18, the second cross beam 2102 and the end connecting hook 221 constitute the first assembly. In the figure, two end connecting hooks 221 are provided, one is fixed at a lower side of a left end of the second cross beam 2102, and the other is fixed at a lower side of a right end of the second cross beam 2102. With reference to Figure 13, two end longitudinal support members 222 are further provided, one is fixed at a rear side of the left end of the second cross beam 2102, and the other is fixed at a rear side of the right end of the second cross beam 2102. Two end transverse limiting members 223 are further provided, one is fixed at an upper side of the left end of the second cross beam 2102, and the other is fixed at an upper side of the right end of the second cross beam 2102.

[0102] As shown in Figure 19, the first cross beam 2101, the first longitudinal beam 2103, the second longitudinal beam 2104 and the impact seat 2110 constitute the second assembly.

[0103] As shown in Figure 20, the saddle mounting seat 2114 and the buffer mounting seat 2115 are fixed inside the end traction beam 2109, to constitute the third assembly. The end traction beam 2109 includes a traction upper plate and a traction lower plate arranged in parallel, and a traction web arranged between the traction upper plate and the traction lower plate. The traction upper plate is provided with a plate opening for the saddle mounting seat 2114 to be exposed.

[0104] As shown in Figure 21, the third longitudinal beam and the fourth longitudinal beam have the same structure, each of which include a channel beam with an opening facing upward, a cover plate covering the opening of the channel beam, and a circular pipe transversely passing through the channel beam.

[0105] As shown in Figure 22, the first bolster and the second bolster have the same structure, each of which include a bolster upper plate, a bolster lower plate, two bolster webs, and two bolster partition plates.

[0106] As shown in Figure 15, the two end side bearings have the same structure. As shown in Figure 23, each of the end side bearings includes a side bearing bottom plate, three side bearing vertical plates, a side bearing adjustment backing plate and a side bearing wear plate. The three side bearing vertical plates are connected on the side bearing bottom plate and the three are connected to form an "I" shape. The side bearing adjustment backing plate is connected below the side bearing bottom plate, the side bearing wear plate is connected below the side bearing adjustment backing plate, and the above three are connected together by bolts, nuts and washers.

[0107] Further, as shown in Figure 13, the end underframe body 21 further includes two container lock seats 2111. One container lock seat 2111 is fixed at an upper side of the third longitudinal beam 2105, the first bolster 2107 and the second cross beam 2102; and the other container lock seat 2111 is fixed at an upper side of the fourth longitudinal beam

2106, the second bolster 2108, and the second cross beam 2102, which may specifically be fixed by welding. In the figure, the two container lock seats 2111 have the same structure.

[0108] As shown in Figure 24, the container lock seat 2111 includes a packaging bottom plate which is horizontally arranged, longitudinal packaging vertical plates connected to left and right sides of the packaging bottom plate, and three transverse packaging vertical plates connected between the two longitudinal packaging vertical plates. One transverse packaging vertical plate is located at an end of the packaging bottom plate, and the other two transverse packaging vertical plates are located in the middle of the packaging bottom plate. A rib plate is arranged between the two transverse packaging vertical plates located in the middle and the packaging bottom plate, and the rib plate is located between the two transverse packaging vertical plates located in the middle.

[0109] Further, as shown in Figure 15, the end underframe body 21 further includes a reinforcing plate 2113. There are two sets of reinforcing plates 2113 in Figure 15, One set is connected between the second cross beam 2102 and the third longitudinal beam 2105, and the other set is connected between the second cross beam 2102 and the fourth longitudinal beam 2106. The two sets of reinforcing plates 2113 have the same structure. As shown in Figure 25, each set of reinforcing plates 2113 includes one transverse rib plate and two triangular rib plates.

[0110] The structure of the joint underframe 3 is similar to that of the end underframe 2 to some extent, especially at the end connecting mechanism 22. Specifically, Figure 26 is a view showing the structure of a joint underframe; Figure 27 is a side view in which the joint underframe in Figure 26 is mounted on the bogie and connected with the holding part; Figure 28 is a view showing the structure of a joint underframe sub-portion of Figure 26; Figure 29 is a view showing Figure 28 from another perspective; Figure 30 is a view showing the structure of another joint underframe sub-portion in Figure 26; Figure 31 is an exploded view of Figure 28; Figure 32 is an enlarged view of a joint longitudinal support member in Figure 31; Figure 33 is an enlarged view of a joint transverse limiting member in Figure 31; Figure 34 is an enlarged view of a first assembly in Figure 31; Figure 35 is an enlarged view of a second joint cross beam and a third joint cross beam in Figure 31; Figure 36 is an enlarged view of a joint side bearing in Figure 31; and Figure 37 is an enlarged view of a set of reinforcing plates in Figure 31.

[0111] As shown in Figure 26, the joint underframe sub-portion 3a includes a joint underframe body 31, a joint connecting mechanism 32, and a joint 33. The joint connecting mechanism 32 is the end connecting mechanism 3 mounted at the joint underframe 3 and is fixed at a rear end of the joint underframe body 31, and the joint 33 is fixed at a front end of the joint underframe body 31. It should be noted that, ends of the two joint underframe sub-portions 3a, close to each other, are front ends of the two, and other ends away from each other are rear ends of the two. In application, the joints 33 of the two joint underframe sub-portions 3a are connected by a joint bearing. In a connected state, the two joint underframe sub-portions 3a are able to rotate about the transverse and vertical directions, to meet the flexibility requirements when the vehicle makes turns or runs on ramps.

[0112] As shown in Figure 27, in application, each joint underframe sub-portion 3a is connected to one holding part 4, so that two adjacent holding parts 4 are connected by the joint underframe 3. A bogie is provided under the two joint underframe sub-portions 3a, that is, the two joint underframe sub-portions 3a (one joint underframe 3) are correspondingly mounted on one bogie.

[0113] As shown in Figure 28 and Figure 30, the joints 33 of the two joint underframe sub-portions 3a have different structures. The joint 33 of one joint underframe sub-portion 3a is configured as a concave joint, and the joint of the other joint underframe sub-portion 3a is configured as a convex joint. In a connected state, the convex joint extends into the concave joint to realize a rotatably connection.

[0114] The joint connecting mechanisms 32 of the two joint underframe sub-portions 3a have the same structure, and the joint underframe bodies 31 also have the same structure. In the connected state, the joint connecting mechanisms 32 of the two joint underframe sub-portions 3a are symmetrical with each other with respect to the transverse direction, and the joint underframe bodies 31 of the two joint underframe sub-portions 3a are also symmetrical with each other with respect to the transverse direction. The specific structure of the joint connecting mechanism 32 is described first hereinafter, and then the specific structure of the joint underframe body 31 is described.

[0115] As shown in Figure 28, the joint connecting mechanism 32 includes a joint connecting hook 321. The joint connecting hook 321 has a hook opening facing upward, and an inner hook face of the joint connecting hook 321 is provided with a joint groove 321a extending in the transverse direction.

[0116] As shown in Figure 27, in the connected state, the lower circular shaft 412c of the holding part 4 is placed in the joint groove 321a, and receives an upward supporting force from an inner surface of the joint groove 321a, so that it is effectively supported in the vertical direction. Meanwhile, the inner surface of the joint groove 321a is able to longitudinally limit the lower circular shaft 412c to some extent. Therefore, the connection between the joint underframe 3 and the holding part 4 has good reliability. Moreover, by applying an upward lifting force to the holding part 4, the lower circular shaft 412c can be released from the joint groove 321a, which facilitates the separation between the joint underframe 3 and the holding part 4.

[0117] Further, as shown in Figure 28, the joint connecting mechanism 32 further includes a joint longitudinal support member 322, the joint longitudinal support member 322 is located above the joint connecting hook 321, which specifically

may be directly above or obliquely above.

[0118] As shown in Figure 32, the joint longitudinal support member 322 includes a joint longitudinal support body 322a and joint wear plates 322b respectively fixed to a front end and a rear end of the joint longitudinal support body 322a.

[0119] As shown in Figure 2, the upper hook 421 is provided at an upper side of the end of the holding part 4, and the hook opening of the upper hook 421 faces downward.

[0120] As shown in Figure 27, in the connected state, the joint longitudinal support body 322a extends into the hook opening of the upper hook 421, and the joint longitudinal support body 322a and the upper hook 421 are hooked together. In this case, the joint wear plate 322b located at the front end abuts against the front side of the inner hook face of the upper hook 421, and the joint wear plate 322b located at the rear end abuts against the rear side of the inner hook face of the upper hook 421, thereby longitudinally supporting the holding part 4. In this way, the reliability of the connection between the joint underframe 3 and the holding part 4 is further improved, and the convenience of separation between the joint underframe 3 and the holding part 4 may not be affected.

[0121] As shown in Figure 32, an upper portion of the joint wear plate 322b located at the front end is inclined backward relative to a lower portion thereof, and an upper portion of the joint wear plate 322b located at the rear end is inclined forward relative to a lower portion thereof.

[0122] Besides, the inner surface of the joint groove 321a forms a joint guide face, and the joint guide face, when cooperating with the lower circular shaft 412c, is able to guide the falling of the holding part 4 during mounting. Moreover, the joint guide face may also cooperate with the lower circular shaft 412c to guide the holding part 4 and the joint underframe 3 to be separated from each other in a rotational manner.

[0123] Specifically, when connecting the holding part 4 and the joint underframe 3, the above-mentioned joint guide face may guide the lower circular shaft 412c to gradually slide into the joint connecting hook 321, so as to guide the mounting of the holding part 4. In addition, when the holding part 4 is continuously falling, the degree of clamping between the joint longitudinal support body 322a and the upper hook 421 may be gradually increased, so that it is convenient for the upper hook 421 to firmly hook the joint longitudinal support body 322a. When separating the holding part 4 and the joint underframe 3, an upward lifting force may be applied to a position of the joint underframe 3 near the rear end (force F in Figure 27), when being lifted to a certain height, the joint underframe 3 is guided by the inner surface of the joint groove 321a to rotate by takings the central axis of the lower circular shaft 412c as the rotation center, which makes the joint longitudinal support body 322a be released from the upper hook 421, thereby facilitating the separation between the joint underframe 3 and the holding part 4. In short, this arrangement may improve the reliability of connection and the convenience of separation between the joint underframe 3 and the holding part 4.

[0124] In the solution shown in the figure, a top of the joint longitudinal support body 322a is a trapezoidal structure with a small upper portion and a large lower portion (see Figure 32), and the joint wear plate 322b at the rear end is positioned lower in height than the joint wear plate 322b at the front end. In this way, it is ensured that the joint underframe sub-portion 3a can smoothly rotate about the transverse direction as described above without interference. Of course, the structure for avoiding interference is not limited to this, and may be adjusted reasonably in actual implementation. In Figure 32, the joint wear plate 322b and the joint longitudinal support body 322a are connected by bolts and nuts. The joint longitudinal support body 322a is of a hollow structure, and a bottom thereof is provided with an oblong hole, which facilitates the replacement of the joint wear plates 322b.

[0125] In the solution shown in the Figure, the joint groove 321a is a cylindrical groove (see Figure 28). In this way, its inner surface may play the above guiding function when cooperating with the cylindrical lower circular shaft 412c. Of course, in actual implementation, the joint groove 321a is not limited to the cylindrical groove.

[0126] Further, as shown in Figure 28, the joint connecting mechanism 32 further includes a joint transverse limiting member 323. The joint transverse limiting member 323 is a limiting guide member provided on the joint underframe 3 and cooperating with the guide limiting member 422 of the holding part 4. The joint transverse limiting member 323 is located above the joint connecting hook 321, which specifically may be directly above or obliquely above. In addition, the joint transverse limiting member 323 is located in front of the joint longitudinal support member 322, which specifically may be directly in front of or obliquely in front of the joint longitudinal support member 322.

[0127] As shown in Figure 33, the joint transverse limiting member 323 includes a joint transverse limiting groove 323a.

[0128] As shown in Figure 27, in the connected state, the guide limiting member 422 is inserted into the joint transverse limiting groove 323a. A left side groove wall and a right side groove wall of the joint transverse limiting groove 323a are located at a left side and a right side of the guide limiting member 422, respectively, to limit the guide limiting member 422 in the transverse direction. In this way, the reliability of the connection between the joint underframe 3 and the holding part 4 may be further improved.

[0129] In the solution shown in the Figure, an upper portion of the left side groove wall and/or an upper portion of the right side groove wall of the joint transverse limiting groove 323a may form a left guide face 323b and a right guide face 323c, respectively (see Figure 33). An upper side of the left guide face 323b is inclined leftward relative to a lower side thereof, and an upper side of the right guide face 323c is inclined rightward relative to a lower side thereof, so that the guide limiting member 422 may be guided into the joint transverse limiting groove 323a.

[0130] In Figure 33, the joint transverse limiting member 323 is composed of a U-shaped plate and two rib plates. In actual implementation, the structure of the joint transverse limiting member 323 is not limited to this.

[0131] As shown in Figure 28 and Figure 29, the joint underframe body 31 includes a first joint cross beam 3101, a second joint cross beam 3102, a third joint cross beam 3103, a first joint longitudinal beam 3104, a second joint longitudinal beam 3105, a joint traction beam 3106, a first joint floor 3107, and a second joint floor 3108.

[0132] The first joint cross beam 3101 is arranged at a rear side of the second joint cross beam 3102 and the third joint cross beam 3103, a left end of the first joint cross beam 3101 is fixed with a left end of the second joint cross beam 3102 through the first joint longitudinal beam 3104, a right end of the first joint cross beam 3101 is fixed with a right end of the third joint cross beam 3103 through the second joint longitudinal beam 3105, and a right end of the second joint cross beam 3102 and a left end of the third joint cross beam 3103 are respectively fixed to a front end of the joint traction beam 3106, thereby forming a joint frame. A rear end of the joint traction beam 3106 is fixed to the first joint cross beam 3101. The beams may be fixed by welding. The joint 33 is fixed at the front end of the joint traction beam 3106, which specifically may be fixed by welding.

[0133] The first joint floor 3107 and the second joint floor 3108 cover a frame opening at a top of the joint frame and are located on left and right sides of the joint traction beam 3106 respectively. The first joint floor 3107 is fixed to the second joint cross beam 3102, the first joint longitudinal beam 3104 and the joint traction beam 3106, and the second joint floor 3108 is fixed to the third joint cross beam 3103, the second joint longitudinal beam 3105 and the joint traction beam 3106, which specifically may be fixed by welding.

[0134] As shown in Figure 34, the first joint cross beam 3101 and the joint connecting hook 321 constitute a first assembly. In the figure, two joint connecting hooks 321are provided, one is fixed at a lower side of a left end of the first joint cross beam 3101, and the other is fixed at a lower side of a right end of the first joint cross beam 3101. In conjunction with Figure 28, two joint longitudinal support members 322 are further provided, one is fixed at a rear side of the left end of the first joint cross beam 3101, and the other is fixed at a rear side of the right end of the first joint cross beam 3101. Two joint transverse limiting members 323 are further provided, one is fixed at an upper side of the left end of the first joint cross beam 3101, and the other is fixed at an upper side of the right end of the first joint cross beam 3101.

[0135] In a specific solution, the second joint cross beam 3102 and the third joint cross beam 3103 have the same structure, and both include a bottom plate, double webs, and a partition plate arranged between the double webs (see Figure 35). The first joint longitudinal beam 3104 and the second joint longitudinal beam 3105 have the same structure, and both are embodied as a channel beam having an opening facing upward (see Figure 31). The first joint floor 3107 and the second joint floor 3108 have the same structure, and both are embodied as a plate structure with a hole in the center. The joint traction beam 3106 includes a traction upper cover plate and a traction lower cover plate, and a traction vertical plate arranged between the traction upper cover plate and the traction lower cover plate.

[0136] Further, as shown in Figure 28, the joint underframe body further includes two joint side bearings 3109, and the two joint side bearings 3109 are located at left and right sides of the joint 33 respectively. One joint side bearing 3109 is fixed at a front side of the second joint cross beam 3102, and the other joint side bearing 3109 is fixed at a front side of the third joint cross beam 3103. In the specific solution, the two joint side bearings 3109 have the same structure. As shown in Figure 36, the joint side bearing includes a side bearing lower cover plate, a side bearing upper cover plate and a side bearing vertical plate arranged between the side bearing lower cover plate and the side bearing upper cover plate.

[0137] Furthermore, as shown in Figure 28, the joint underframe body 31 further includes a reinforcing plate 3110. In the specific solution, two sets of reinforcing plates 3110 (see Figure 31) are provided. One set of reinforcing plates 3110 is fixed between the first joint floor 3107 and the first joint cross beam 3101, and the other set of reinforcing plates is fixed between the second joint floor 3108 and the first joint cross beam 3101. As shown in Figure 37, each set of reinforcing plates 3110 includes one transverse rib plate and two triangular rib plates.

[0138] Both the end underframe 2 and the joint underframe 3 may be equipped with a locking mechanism 5. The locking mechanism 5 may realize locking or unlocking of the holding part 4 and the body part 1 in the vertical direction. Mounting positions of the locking mechanism 5 on the end underframe 2 and the joint underframe 3 are similar.

[0139] In the end underframe 2, referring to Figure 18, the end connecting hook 221 includes an end hook body 221b. The end hook body 221b includes two end hook sub-bodies 221b-1 spaced apart in the transverse direction and an end accommodation cavity 221b-2 formed between the two end hook sub-bodies 221b-1. The locking mechanism 4 may be mounted in the end accommodation cavity 221b-2. In Figure 18, the end connecting hook 221 further includes an end hook wall plate 221c covering an outer hook face of the end hook body 221b. The end hook wall plate 221c is provided with an end first connecting hole 221d, the end first connecting hole 221d is in communication with the end accommodation cavity 221b-2, so that an unlocking member is able to extend into the end accommodation cavity 221b-2 through the end first connecting hole 221d to unlock the locking mechanism. After being unlocked, the holding part 4 can be separated from the end underframe 2. In addition, in Figure 14, the end connecting hook 221 is further provided with an end second connecting hole 221e.

[0140] In the joint underframe 3, the joint connecting hook 321 includes a joint hook body 321b. The joint hook body

321b includes two joint hook sub-bodies 321b-1 spaced apart in the transverse direction and a joint accommodation cavity 321b-2 formed between the two joint hook sub-bodies 321b-1. The locking mechanism 5 may be mounted in the joint accommodation cavity 321b-2. In Figure 34, the joint connecting hook 321 further includes a joint hook wall plate 321c covering an outer hook face of the joint hook body 321b. The joint hook wall plate 321c is provided with a joint first connecting hole 321d, and the joint first connecting hole 321d is in communication with the joint accommodation cavity 321b-2, so that the unlocking member is able to extend into the joint accommodation cavity 321b-2 through the joint first connecting hole 321d to unlock the locking mechanism. After being unlocked, the holding part 4 can be separated from the joint underframe 3.

[0141] Since the mounting structures of the locking mechanism on the end underframe 2 and the joint underframe 3 are similar, in the following description of the specific structure of the locking mechanism, the case that the locking mechanism is mounted on the end underframe 2 is taken as an example. And for the locking mechanism 5, two types of structures are provided according to the embodiments of the present application.

[0142] A first type of locking mechanism 5 may refer to Figure 38 to Figure 44. Figure 38 is a structural view showing that the first type of locking mechanism is mounted on an end connecting hook; Figure 39 is a structural view showing the end connecting hook, the holding part and the first type of locking mechanism in a locked state; Figure 40 is a side view of Figure 39; Figure 41 is a side view of Figure 39 in an unlocked state; Figure 42 is a structural view showing that a first lock body and a first locking and driving beam assembly are connected; Figure 43 is an exploded view of Figure 42; and Figure 44 is a structural view showing that a first limiting portion, a second limiting portion and a first guide sleeve are fixed to the end connecting hook.

[0143] As shown in Figure 38 to Figure 44, the locking mechanism 5 includes:

a first lock body 51, wherein the first lock body 51 is hinged with the end connecting hook 221 through a third hinge shaft 52. One end of the first lock body 51 is a locking end 511, and the other end is a first limiting end 512. The third hinge shaft 52 is located between the locking end 511 and the first limiting end 512;

a first limiting portion 53, wherein the first limiting portion 53 is fixed in the end accommodation cavity 221b-2 (see Figure 44); and

a first locking and driving beam assembly 54 which is connected to the first lock body 51.

[0144] In a locked state, as shown in Figure 40, the first limiting end 512 abuts against the first limiting portion 53 from top to bottom, and the locking end 511 abuts against the holding part 4 to lock the holding part 4; in an unlocked state, as shown in Figure 41, the first locking and driving beam assembly 54 may drive the first limiting end 512 to be disengaged from the first limiting portion 53 from bottom to top, and the locking end 511 to rotate to be separated from the holding part 4.

[0145] With this structure, as shown in Figure 40 and Figure 41, in the locked state, if there is a tendency of separation between the holding part 4 and the end connecting hook 221, the holding part 4 may apply an upward force to the locking end 511, to drive the locking end 511 to rotate counterclockwise. However, due to the bottom-up supporting force applied by the first limiting portion 53 on the first limiting end 512, the counterclockwise rotation of the first lock body 51 may be blocked, so that the position of the locking end 511 may remain unchanged, and thus the holding part 4 can be reliably locked. When being unlocked, the first locking and driving beam assembly 54 is able to drive the first limiting end 512 to be disengaged from the first limiting portion 53 from bottom to top. The first lock body 51 may rotate clockwise, and its rotation direction is opposite to a stopping direction of the first limiting portion 53. The locking end 511 and the holding part 4 may be separated smoothly, and the smooth unlocking of the holding part 4 may be realized without affecting the separation between the holding part 4 and the end connecting hook 221.

[0146] Here, the embodiment of the present application does not limit the structure of the first limiting portion 53, which may be plate-shaped or block-shaped. Similarly, the embodiment of the present application does not limit the number of the first limiting portion 53, which may be one, or may include multiple independent limiting members, as long as the above-mentioned technical effects can be achieved.

[0147] In a detailed solution, as shown in Figure 42, the first locking and driving beam assembly 54 may include a first push beam 541, a first guide sleeve 542, and a transmission beam 543. The first guide sleeve 542 is fixed in the end accommodation cavity 221b-2 (see Figure 44). The first push beam 541 is slidably connected to the first guide sleeve 542. One end of the transmission beam 543 may be hinged with the first lock body 51, and the other end may be hinged with the first push beam 541.

[0148] In this way, when the first push beam 541 moves upward under a driving force, the transmission beam 543 which is hinged may convert a linear motion of the first push beam 541 into a rotational motion of the first lock body 51, so as to transmit the driving force for unlocking to the first lock body 51, thus realizing the unlocking of the first lock body 51. When the driving force disappears, the first push beam 541 may automatically slide down along the first guide sleeve 542 under its own gravity, to drive the first lock body 51 to rotate reversely, so as to realize the automatic locking of the

first lock body 51. Of course, the first push beam 541 may be driven to realize reset and locking by a reverse driving force applied by an external device.

[0149] Specifically, the first push beam 541 may directly face the end first connecting hole 221d (see Figure 40 and Figure 41), so that the unlocking member is able to be in contact with the first push beam 541 through the end first connecting hole 221d, to apply an upward driving force for unlocking to the first push beam 541.

[0150] It should be noted that the embodiment of the present application does not limit the source of the driving force that the first push beam 541 receives when unlocking, and a solution of manual driving may be employed. For example, an unlocking member such as an unlocking lever may be provided, when unlocking is required, the unlocking member may be manually operated by an operator, to apply the driving force to the first push beam 541. Or, a solution of automatic driving may be employed; in this case, a power source may be a motor, an air cylinder, an oil cylinder, etc. The power source may be mounted on the vehicle body or on the ground equipment, which may be selected according to the actual situation. A transmission mechanism may further be provided between the power source and the first push beam 541, to transmit the driving force of the power source.

[0151] A beam section of the first push beam 541 located above the first guide sleeve 542 may further be provided with a first connecting sleeve 541a. As shown in Figure 43, the first connecting sleeve 541a may be a U-shaped plate, and a bottom plate portion of the U-shaped plate may be connected with the first push beam 541 and may form support with the first guide sleeve 542, so as to serve as a limiting member for the downward movement of the first push beam 541. The transmission beam 543 may be hinged between two side plate portions of the U-shaped plate.

[0152] In fact, the limiting of the downward movement of the first push beam 541 may also be realized by cooperation between the first limiting end 512 and the first limiting portion 53. In this way, the above-mentioned first connecting sleeve 541a may be omitted. Or, the transmission beam 543 may be used for limiting, the transmission beam 543 and the first push beam 541 are hinged, and they are generally arranged to have an included angle therebetween in the actual operating process, thus the transmission beam 543 may also serve as a limiting member for the downward movement of the first push beam 541.

[0153] In the above solution, the linear motion of the first push beam 541 is converted into the rotational motion of the first lock body 51 through the transmission beam 543. In fact, in addition to this solution, other solutions may also be employed. For example, a guide hole may be provided on the first lock body 51, and the first push beam 541 may be hinged in the guide hole. When the first push beam 541 is axially displaced, a hinge shaft of the first push beam 541 can slide in the guide hole, to naturally drive the first lock body 51 to rotate, which also realizes the conversion from the linear motion to the rotational motion.

[0154] Further, the locking mechanism 5 may include a locking first elastic piece 541b. One end of the locking first elastic piece 541b may interact with the first push beam 541, and the unlocking process is a process in which a deformation amount of the locking first elastic piece 541b increases, to gather an elastic force. With this arrangement, after the driving force for the first push beam 541 disappears, the elastic force of the locking first elastic piece 541b may be released, to cooperate with the gravity of the first push beam 541, so as to jointly drive the reset and locking of the first lock body 51.

[0155] Specifically, the locking first elastic piece 541b may be a spring, which may be sleeved and mounted on the first push beam 541. A first support member 541c may be arranged at a lower end of the first push beam 541, and two ends of the spring may interact with the first guide sleeve 542 and the first support member 541c, respectively. The first push beam 541 may serve as a spring post, which is beneficial to preventing radial play of the spring during the expansion and contraction process, thereby having positive effects on improving the stability of the structure and the reliability of the power transmission. Besides, with this structure, in the unlocked state, the first push beam 541 may move upward, and the locking first elastic piece 541b may be compressed; while the locking state is restored, the first push beam 541 may move downward, and the locking first elastic piece 541b may be released.

[0156] In fact, in the locked state, the locking first elastic piece 541b may also have a certain pre-compression amount. That is, in the locked state, the locking first elastic piece 541b may still provide a certain elastic force, which has a positive effect on ensuring the stability of the locked state of the first lock body 51, thereby avoiding automatic unlocking of the first lock body 51 when the rail vehicle runs along a curve.

[0157] In order to conveniently adjust the pre-compression amount, the first support member 541c may be a nut. In this way, by changing the position where the nut is screwed, a distance between the first support member 541c and the first guide sleeve 542 may be adjusted, and the pre-compression amount of the locking first elastic piece 541b in the locked state may be adjusted.

[0158] In the unlocked state, the locking first elastic piece 541b may actually be in a stretched state, in this case, the mounting position of the locking first elastic piece 541b may be changed. Specifically, the locking first elastic piece 541b may be arranged between the first connecting sleeve 541a and the first guide sleeve 542, with its both ends fixedly connected to the first connecting sleeve 541a and the first guide sleeve 542, so as to transmit a tensile force.

[0159] The first lock body 51 may be provided with a mounting groove 513, and the transmission beam 543 may be hinged in the mounting groove 513. In this way, a thickness of the locking mechanism in an axial direction of a hinge shaft between the transmission beam 543 and the first lock body 51 may be smaller, and the overall structure may be

more compact. In addition, the mounting groove 513 may also be arranged in the transmission beam 543, and the first lock body 51 may be hinged in the mounting groove 513 of the transmission beam 543. Or, the mounting groove 513 may not be provided, in this case, a thickness of an assembly formed by the transmission beam 543 and the first lock body 51 in the axial direction of the hinge shaft between the transmission beam 543 and the first lock body 51 may be relatively large.

[0160] Further, the locking mechanism 5 may include a second limiting portion 55 fixedly arranged, and the second limiting portion 55 may be fixed in the end accommodation cavity 221b-2. The structure of the second limiting portion may be similar to the first limiting portion 53, which is not repetitively descriped herein. The first lock body 51 may further include a second limiting end 514. In the locked state, the second limiting end 514 may abut against the second limiting portion 55 from bottom to top.

[0161] In this way, in the locked state, the first lock body 51 may form a three-point support solution, thus the first lock body 51 is subjected to more balanced forces, and the first lock body 51 is more reliable in locking the holding part 4.

[0162] In detail, the first lock body 51 may include two lock arms arranged to have an included angle therebetween, and the two lock arms may substantially form an L shape. The third hinge shaft 52 may be arranged at the junction between the two lock arms, that is, at the corner of the L shape. An end of one lock arm away from the third hinge shaft 52 may be the locking end 511, and an end of the other lock arm away from the third hinge shaft 52 may be the first limiting end 512. A small included angle (<180 degrees) and a large included angle (>180 degrees) are formed between the two lock arms. A side where the small included angle is located is an inner end of the junction, and a side where the large included angle is located is an outer end of the junction. The outer end may serve as the second limiting end 514 described above.

[0163] With reference to Figure 40, in the locked state, the first limiting portion 53 may apply a bottom-up supporting force to the first limiting end 512, and the second limiting portion 55 may apply a top-down supporting force to the second limiting end 514, cooperating with an upward pushing force applied by the holding part 4 to the locking end 511, the forces born by the first lock body 51 may be more balanced. Moreover, through the interaction of the three force-bearing points, the third hinge shaft 52 is basically in an unstressed state, which has a positive effect on ensuring the reliability of the locking mechanism.

[0164] In the locking mechanism 5 of the above type, in addition to the mounting support points formed by the first guide sleeve 542, the first limiting portion 53 and the second limiting portion 55, the third hinge shaft 52 may also serve as a mounting support point. Specifically, in conjunction with Figure 43, a slot may be provided on an outer wall of the third hinge shaft 52. A locking mounting plate 521 may be provided in the slot (the locking mounting plate 521 and the third hinge shaft 52 may also be connected by welding). The locking mounting plate 521 may be connected to the end connecting hook 221 by a connecting piece in the form of a bolt 522, etc. Of course, in addition to the bolt connection, the locking mounting plate 521 and the end connecting hook 221 may also be fixedly connected by welding or the like.

[0165] The structure of a second type of locking mechanism 5 may refer to Figure 45 to Figure 54, Figure 45 is a structural view showing that the second type of locking mechanism is mounted on the end connecting hook; Figure 46 is a view showing the end connecting hook, the holding part and the second locking mechanism in a locked state; Figure 47 is a view showing the end connecting hook, the holding part and the second locking mechanism in an unlocked state; Figure 48 is a view showing that a second guide sleeve, a fourth limiting portion, and a rotary support body are fixed to the end connecting hook; Figure 49 is a structural view showing that a second push beam is connected with a connecting beam unit and a second lock body; Figure 50 is a schematic view showing the structure of a second connecting sleeve; Figure 51 is a schematic view showing the structure of an adapting block; Figure 52 is a schematic view showing the structure of a lock head; Figure 53 is a schematic view showing the structure of the second lock body; and Figure 54 is a schematic view showing the structure of the rotary support body.

[0166] When the locking mechanism 5 is locked, the holding part 4 and the end connecting hook 221 can be locked in the vertical direction, which ensures the reliable connection between the holding part 4 and the end connecting hook 221 and the driving safety; while in the unlocked state, the convenience of separation between the holding part 4 and the end connecting hook 221 is not affected.

[0167] As shown in Figure 45 to Figure 54, the locking mechanism 5 includes: a lock head 51', wherein the lock head 51' is rotatably connected to the end connecting hook 221, and the lock head 51' is provided with a locking portion 511' and a support portion 512' at two sides of its rotational center line respectively; a second lock body 52', wherein the second lock body 52' is slidably connected to the end connecting hook 221; and a second locking and driving beam assembly 53', which is in transmission connection with the second lock body 52'. In a locked state, the second lock body 52' supports the support portion 512' from bottom to top, to make the locking portion 511' press the holding part; in an unlocked state, the second locking and driving beam assembly 53' is able to drive the second lock body 52' to displace in a direction away from the lock head 51', and the support portion 512' is able to rotate downward about the rotational center line, to make the locking portion 511' rotate upward to be separated from the holding part.

[0168] With this structure, in conjunction with Figure 46, in the locked state, if there is a tendency of separation between the holding part and the end connecting hook 221, the holding part may apply an upward force to the locking portion

511', to drive the lock head 51' to rotate counterclockwise. However, due to the bottom-up supporting force applied by the second lock body 52' to the support portion 512', the counterclockwise rotation of the lock head 51' may be blocked, so that the position of the locking portion 511' may remain unchanged, and thus the holding part 4 can be reliably locked. With reference to Figure 47, when being unlocked, the second locking and driving beam assembly 53' may drive the second lock body 52' to slide in a direction away from the lock head 51', the support portion 512' may rotate downward about the rotational center line, and the locking portion 511' may rotate upward, to release the locking of the holding part without affecting the separation between the holding part 4 and the end connecting hook 221.

[0169] The lock head 51' is arranged in a rotatable manner, which may specifically be hinged. In this case, the lock head 51' may be provided with a hinge shaft, and the hinge shaft may be fixed to the end connecting hook 221 and located between the locking portion 511' and the support portion 512'. Or, a rotary support body 54' may be provided, the rotary support body 54' may be fixed to the end connecting hook 221, and the rotary support body 54' may be provided with a rotary shaft portion 541'. The rotary shaft portion 541' has an arc-shaped cylindrical surface, and the lock head 51 may be provided with an arc-shaped notch 513' matching the rotary shaft portion 541'. Herein, matching means that an outer diameter of the rotary shaft portion 541' is substantially the same as an inner diameter of the arc-shaped notch 513'. During assembly, the lock head 51' may be inserted into the rotary shaft portion 541' through the arc-shaped notch 513', and is able to rotate by taking a central axis of the rotary shaft portion 541' as the rotational center line, and thus the lock head 51' is arranged in the rotatable manner.

[0170] When being unlocked, the rotation of the lock head 51' may be realized by the offset of a center of gravity, and the center of gravity of the lock head 51' may deviate from the rotational center line in the longitudinal direction and is located at a side where the support portion 512' is located. Specifically, with reference to Figure 46, the arc-shaped notch 513' may be arranged at a right side of the center of gravity of the lock head 51'. In this way, when the second lock body 52' is displaced leftward, the lock head 51' may naturally rotate counterclockwise, to release the locking of the holding part.

[0171] And/or, the lock head 51' may be provided with a third elastic piece in the form of a spring or the like. In the locked state, the third elastic piece may gather an elastic force in the form of a tensile force or a compressive force, etc. When the second lock body 52' gradually moves away, the elastic force of the third elastic piece may be released, thus driving the lock head 51' to automatically rotate and be unlocked. In comparison, both of the above two methods may realize the automatic rotation of the lock head 51' when being unlocked. In specific implementation, those skilled in the art may make a selection according to actual needs.

[0172] With reference to Figure 48, in specific assembly, the number of the rotary support body 54' may be two, in this way, the lock head 51' may be arranged on the two rotary support bodies 54', and thus the mounting stability of the lock head 51' is higher. In addition, the second lock body 52' may be inserted into a space between the two rotary support bodies 54', and thus the connection structure of the lock head 51', the second lock body 52' and the rotary support bodies 54' may be more compact.

[0173] As shown in Figure 54, the rotary support body 54' may further include a third limiting portion 542', and the third limiting portion 542' may be angular-shaped, etc.. In the unlocked state, the third limiting portion 542' may abut against the support portion 512', so as to limit the downward rotation of the support portion 512'. Meanwhile, a gap for the second lock body 52' to be inserted from below the support portion 512' is formed by supporting of the third limiting portion 542', so as to facilitate the second lock body 52' to be inserted again, and thereby supporting the support portion 512'.

[0174] Herein, the embodiment of the present application does not limit a supporting height of the third limiting portion 542'. In specific implementation, those skilled in the art may set it according to actual needs, as long as it is ensured that when supporting is performed by the third limiting portion 542' and the support portion 512', the locking portion 511' is able to unlock the holding part and the gap for inserting the second lock body 52' is reserved.

[0175] Furthermore, as shown in Figure 52, the lock head 51' may further be provided with a support groove 514'. When unlocking is performed, the third limiting portion 542' may be inserted into the support groove 514'. It may be understood that a depth that the third limiting portion 542' is inserted into the support groove 514' actually determines the supporting height of the support portion 512' when unlocking. Therefore, in specific practice, the support height of the support portion 512' may also be adjusted by adjusting the depth of the support groove 514'.

[0176] With reference to Figure 53, the second lock body 52' may include an insertion section 521' with an inclined guide face. When locking is performed, the insertion section 521' may be inserted from below the support portion 512', and may support the support portion 512' via the inclined guide face, so as to gradually drive the support portion 512' to rotate upward and the locking portion 511' to rotate downward, and thus locking the holding part.

[0177] The second lock body 52' may only include the insertion section 521', in this case, when in the locked state, the second lock body 52' may still support the support portion 512' via the inclined guide face. In the unlocked state, the second lock body 52' may be completely separated from the support portion 512', or may support the support portion 512' via the inclined guide face; in other words, when unlocking is performed, the second lock body 52' and the lock head 51' may not be completely separated. In this case, the second lock body 52' itself may limit the rotation of the lock

head 51', and since the lock head 51' is still on the second lock body 52', the problem that the second lock body 52' may not be inserted does not exist, and the aforementioned third limiting portion 542' may be omitted.

[0178] In the solution of the figures, with continued reference to Figure 53, the second lock body 52' may include three parts, namely, a large-sized support section 523' with a large vertical size, the insertion section 521' with a varying vertical size, and a small-sized support section 524' with a small vertical size. The large-sized support section 523' has a first support plane, and the small-sized support section 524' has a second support plane. In the locked state, the second lock body 52' may support the support portion 512' via the first support plane. In the unlocked state, the second lock body 52' may support the support portion 512' via the second support plane.

[0179] Since the surface supporting the support portion 512' is a flat surface, the lock head 51' may have higher stability during unlocking and locking. Based on the above arrangement, the support portion 512' and the second lock body 52' are not completely separated when being unlocked, and the small-sized support section 524' may naturally form limiting for the rotation of the support portion 512', and the third limiting portion 542' may be omitted.

[0180] As a modified solution of the solution shown in Figure 53, the second lock body 52' may only include the large-sized support section 523' (or the small-sized support section 524') and the insertion section 521', which may also realize the function of the second lock body 52'.

[0181] A guide structure may be provided between the second lock body 52' and the rotary support body 54', so as to guide a sliding direction of the second lock body 52'.

[0182] Specifically, one of the second lock body 52' and the rotary support body 54' may be provided with a slide groove 522', and the other may be provided with a sliding portion matching the slide groove 522'. The sliding portion may be inserted into the slide groove 522' and is able to slide along the slide groove 522'. The sliding portion may be an integral structure such as an elongated slide rail 543' shown in the figure, or may also be a split structure, for example, it may include a plurality of sliding blocks spaced apart.

[0183] Further, a fourth limiting portion 55' which is fixedly arranged may be further provided, and the fourth limiting portion 55' may be fixed in the end accommodation cavity 221b-2. In the locked state, the fourth limiting portion 55' may abut against the support portion 512' from top to bottom.

[0184] In this way, in the locked state, a three-point support solution of the lock head 51' may be formed, thus the forces born by the lock head 51' are more balanced, and the lock head 51' may be more reliable for the locking of the holding part. Moreover, due to the interaction of the three stress points, there is basically no action of forces between the arc-shaped notch 513' and the rotary shaft portion 541', which has a positive effect on ensuring the reliability of the locking mechanism.

[0185] Herein, the embodiment of the present application does not limit the structure of the fourth limiting portion 55', which may be plate-shaped or block-shaped. Similarly, the embodiment of the present application does not limit the number of the fourth limiting portion 55', which may be one, or may include multiple mutually independent limiting members, as long as the above technical effects can be achieved.

[0186] Please refer to Figure 49, combined with Figure 46, Figure 47, in an exemplary solution, the second locking and driving beam assembly 53' may include a second push beam 531', a second guide sleeve 532', and a connecting beam unit 533'. The second guide sleeve 532' may be fixedly arranged, which specifically may be mounted in the end accommodation cavity 221b-2 (see Figure 48). The second push beam 531' and the second guide sleeve 532' may be slidably connected. One end of the connecting beam unit 533' is hinged with the second push beam 531', and the other end is hinged with the second lock body 52'.

[0187] With this structure, when the second push beam 531' moves upward under a driving force, the connecting beam unit 533' which is hinged may drive the second lock body 52' to slide in a direction away from the lock head 51', and then the lock head 51' may rotate and be unlocked by itself. When the driving force disappears, the second push beam 531' may automatically slide down along the second guide sleeve 532' under its own gravity, and drive, via the connecting beam unit 533', the second lock body 52' to slide toward the lock head 51', so as to support the support portion 512' again, and the lock head 51' may rotate reversely to realize automatic locking. Of course, the second push beam 531' may be driven to realize reset and locking by a reverse driving force applied by an external device.

[0188] Specifically, the second push beam 531' may directly face the end first connecting hole 221d (see Figure 46 and Figure 47), so that the unlocking member is able to pass through the end first connecting hole 221d to be in contact with the second push beam 531', thereby applying an upward driving force for unlocking to the second push beam 531'.

[0189] It should be noted that the embodiment of the present application does not limit the source of the driving force that the second push beam 531' receives when unlocking, and a solution of manual driving may be employed. For example, an unlocking member such as an unlocking lever may be provided, when unlocking is required, the unlocking member may be manually operated by an operator, to apply the driving force to the second push beam 531'. Or, a solution of automatic driving may be employed; in this case, a power source may be a motor, an air cylinder, an oil cylinder, etc. The power source may be mounted on the vehicle body or on the ground equipment, which may be selected according to the actual situation. A transmission mechanism may further be provided between the power source and the second push beam 531', to transmit the driving force of the power source.

[0190] A beam section of the second push beam 531' located above the second guide sleeve 532' may further be provided with a second connecting sleeve 531a'. As shown in Figure 50, the second connecting sleeve 531a' may specifically include a pipe portion and a hinge portion. The pipe portion may be mounted at an upper portion of the second push beam 531' through threaded connection, welding, interference fit, etc.. The hinge portion may include two hinge plates arranged opposite to each other, and the aforementioned connecting beam unit 533 ' may be hinged between the two hinge plates.

[0191] The above second connecting sleeve 531a' and the second guide sleeve 532' may cooperate with each other to serve as a limiting member for limiting the downward movement of the second push beam 531', to limit a maximum downward movement distance of the second push beam 531', and a displacement distance of the second lock body 52' is also limited at the same time.

[0192] In fact, the limiting of the downward movement of the second push beam 531' may also be realized by cooperation between the lock head 51 ' and the fourth limiting portion 55'. In this way, the above second connecting sleeve 531a' may be omitted. Or, a connecting end of the connecting beam unit 533' connected to the second push beam 531' may be used for limiting. The connecting end is connected to the second push beam 531' in a hinged manner, and the two are generally arranged to have an included angle therebetween during the actual operating process. Therefore, even if there is no second connecting sleeve 531a', the connecting end may also serve as a limiting component for the downward movement of the second push beam 531'.

[0193] Further, a second elastic piece 531b' may be provided. One end of the second elastic piece 531b' may interact with the second push beam 531', and in the unlocked state, a deformation amount of the second elastic piece 531b' may be increased, to gather an elastic force. With this arrangement, after the driving force for the second push beam 531' disappears, the elastic force of the second elastic piece 531b' may be released, to cooperate with the gravity of the second push beam 531', so as to jointly drive the reset and locking of the lock head 51'.

[0194] Specifically, the second elastic piece 531b' may be a spring, which may be sleeved and mounted on the second push beam 531'. A second support member 531c' may be provided at a lower end of the second push beam 531', and two ends of the spring may abut against the second guide sleeve 532' and the second support member 531c', respectively. The second push beam 531' may serve as a spring post, which is beneficial to preventing radial play of the spring during the expansion and contraction process, thereby having positive effects on improving the stability of the structure and the reliability of power transmission. Besides, with this structure, in the unlocked state, the second push beam 531' may move upward and the second elastic piece 531b' may be compressed, while when the locking state is restored, the second push beam 531' may move downward, and the second elastic piece 531b' may be released.

[0195] In fact, in the locked state, the second elastic piece 531b' may also have a certain pre-compression amount. That is, in the locked state, the second elastic piece 531b' may still provide a certain elastic force, which has a positive effect on ensuring the stability of the locked state of the lock head 51', thereby avoiding automatic unlocking of the lock head 51' when the rail vehicle runs along a curve.

[0196] In order to conveniently adjust the pre-compression amount, the second support member 531c' may be a nut. In this way, by changing the position where the nut is screwed, a distance between the second support member 531c' and the second guide sleeve 532' may be adjusted, and then the pre-compression amount of the second elastic piece 531b' in the locked state may be adjusted.

[0197] In the unlocked state, the second elastic piece 531b' may actually be in a stretched state, in this case, the mounting position of the second elastic piece 531b' may be changed. Specifically, the second elastic piece 531b' may be arranged between the second connecting sleeve 531a' and the second guide sleeve 532', with its both ends of fixedly connected to the second connecting sleeve 531a' and the second guide sleeve 532', so as to transmit a tensile force.

[0198] The connecting beam unit 533' may be a structure formed by a combination of multiple connecting beams. In an exemplary solution, the connecting beam unit 533' may include a first locking connecting beam 533a', a second locking connecting beam 533b', and an adapting block 533c'. The adapting block 533c' may be provided with a fixed hinge point 533c-1', a first hinge point 533c-2' and a second hinge point 533c-3' which are non-collinear to one another. The fixed hinge point 533c-1' may be fixedly arranged, which specifically may be fixed at the end connecting hook 221. One end of the first locking connecting beam 533a' may be hinged to the second push beam 531', and the other end may be hinged to the first hinge point 533c-2'. One end of the second locking connecting beam 533b' may be hinged to the second lock body 52', and the other end may be hinged to the second hinge point 533c-3'.

[0199] With this structure, as shown in Figure 46 and Figure 47, when the second push beam 531' moves upward, the first locking connecting beam 533a' is driven to move upward, then the adapting block 533c' is driven to rotate clockwise around the fixed hinge point 533c-1', and the adapting block 533c' drives the second locking connecting beam 533b' and the second lock body 52' to move leftward, and then the lock head 51' is able to rotate counterclockwise, so as to unlock the holding part. When the second push beam 531' moves downward, the first locking connecting beam 533a' is driven to move downward, then the adapting block 533c' is driven to rotate counterclockwise, and the adapting block 533c' drives the second locking connecting beam 533b' and the second lock body 52' to move rightward, and then the lock head 51' is able to rotate clockwise, so as to re-lock the holding part.

[0200] It should be noted that the above description of the specific structure of the second locking and driving beam assembly 53' is only a preferred solution of the embodiment of the present application, and cannot be used to limit the implementation scope of the vehicle body of the piggyback vehicle according to the present application. Under the condition that the functions can be satisfied, other forms of the second locking and driving beam assembly 53' may also be employed. For example, the second locking and driving beam assembly 53' may employ a beam arranged to be able to perform linear displacement.

[0201] Further, as shown in Figure 1, the body part 1 is further provided with a transverse stop mechanism 6. When the holding part 4 moves from a position separated from the end underframe 2 to a position connected with the end underframe 2 to be reset, the transverse stop mechanism is able to determine the reset position of the holding part 4, to ensure that the holding part 4 is accurately mounted on the body part 1.

[0202] Specifically, the transverse stop mechanism 6 may be mounted on the end underframe 2 or the joint underframe 3. Since the mounting structure is similar, the structure of the transverse stop mechanism 6 is described hereinafter by only taking the case that it is mounted on the end underframe 2 as an example. Similarly, two structural types of the transverse stop mechanism 6 are provided according to the embodiments of the present application.

[0203] The structure of a first type of transverse stop mechanism 6 may refer to Figure 55 to Figure 61. Figure 55 is a structural view showing that the first type of transverse stop mechanism is mounted on the end connecting hook; Figure 56 is a structural view showing a specific embodiment of the first type of transverse stop mechanism; Figure 57 is an exploded view of Figure 56; Figure 58 is a structural view showing a support seat; Figure 59 is an exploded view of the first connecting beam; Figure 60 is a structural view showing another specific embodiment of the first type of transverse stop mechanism; and Figure 61 is an exploded view of a connection structure between a first stop beam and a connecting end in Figure 60.

[0204] As shown in Figure 55 to Figure 57, the first type of transverse stop mechanism 6 includes: a support seat 61, the support seat 61 is fixed to the end connecting hook 221, which specifically may be fixed by welding or the like, and the support seat 61 is provided with a through hole 611; a first stop beam 62; a stopping and driving beam assembly 63, which is in transmission connection with the first stop beam 62. In a stopping state, the first stop beam 62 may extend out of the through hole 611 to stop the holding part 4 in the transverse direction. In an unblocking state, the stopping and driving beam assembly 63 may drive the first stop beam 62 to retract, so as to release the stopping of the holding part 4.

[0205] With this structure, in the stopping state, the first stop beam 62 can extend from the through hole 611 to stop the holding part 4 in the transverse direction, thereby ensuring the accurate reset of the holding part 4; while in the unblocking state, the stopping and driving beam assembly 63 can act on the first stop beam 62 to make it retract, so as to release the stopping of the holding part 4, thereby not affecting the normal separation between the holding part 4 and the end underframe 2.

[0206] Further, a third elastic piece 64 may be provided, the third elastic piece 64 may act on the first stop beam 62, and a deformation amount of the third elastic piece 64 may increase in the unblocking process, so as to gather an elastic force. In this way, when the driving force acting on the stopping and driving beam assembly 63 disappears, the third elastic piece 64 may be released to drive the first stop beam 62 to automatically return to the stopping position, which may improve the automation degree of the equipment.

[0207] Referring to Figure 57, the first stop beam 62 may include a thick neck portion 621 and a thin neck portion 622, and a stepped face 623 may be formed therebetween. The third elastic piece 64 may be a spring, which may be sleeved and mounted on the thin neck portion 622 and may interact with the stepped face 623. In this case, the thin neck portion 622 may also serve as a spring post, to guide the expansion and contraction of the spring, which may avoid the radial play of the spring in the expansion and contraction process to a great extent, and has a positive effect on improving the stability and reliability of transmission.

[0208] It should be noted that, in addition to the solution employing the spring, the third elastic piece 64 may also employ elastic elements in other forms, such as elastic balls, elastic blocks and tension ropes, as long as the using effects can be satisfied.

[0209] The support seat 61 may be further provided with a stop limiting member 65, and two ends of the third elastic piece 64 may interact with the stop limiting member 65 and the stepped face 623 respectively. In the solution of the drawings, the first stop beam 62 may take the thick neck portion 621 as a stopping portion, to improve the strength of the stopping portion. When unblocking, the stepped face 623 may apply a compressive force to the third elastic piece 64, to increase a compression amount of the third elastic piece 64. In this solution, the third elastic piece 64 is in contact with both the stop limiting member 65 and the stepped face 623.

[0210] Furthermore, a cross section of the thick neck portion 621 may be non-circular, and the through hole 611 may match the thick neck portion 621, where matching means that the shapes and sizes of the two are substantially the same. In this way, when the thick neck portion 621 is inserted into the through hole 611, the two may not rotate relative to each other, which improves the reliability of stopping and positioning. Further, a stopping surface of the thick neck portion 621 in contact with the holding part 4 may be a flat surface. In this way, a contact area between the holding part 4 and the stopping surface may be relatively large, which improves the reliability of stopping to a greater extent.

[0211] In fact, in the unblocking process, the third elastic piece 64 may also generate a tensile force, in this case, the thin neck portion 622 of the first stop beam 62 may serve as a stopping portion in contact with the holding part 4. In this solution, two ends of the third elastic piece 64 need to be connected with the stop limiting member 65 and the stepped face 623, so as to be able to generate the tensile force when unblocking.

[0212] The structure of the stop limiting member 65 is not limited here, in specific implementation, it may be set by those skilled in the art according to actual needs, as long as the above effects can be achieved. For example, in the solution of Figure 57, the stop limiting member 65 may be in the shape of a sleeve, and the sleeve may be a circular cylinder, a square cylinder or a special-shaped cylinder of other shapes. The sleeve may protect the spring, so as to prevent normal operation of the spring from being affected by interference of rain, dust, etc. to a great extent. In the solution of Figure 60, the stop limiting member 65 may be plate-shaped or block-shaped, which may be connected to the support seat 61 via the stop upper cover plate 615. In this case, the spring is in a relatively open space, and the operator can observe directly, which facilitates the adjustment of the mounting state of the spring.

[0213] With reference to Figure 58, in fact, the embodiment of the present application does not limit the structure of the support seat 61, and its structure is mainly adapted to be connected with the end connecting hook 221. In specific implementation, those skilled in the art may adjust the shape of the support seat 61 according to the end connecting hook 221, and the support seat 61 is required to provide corresponding mounting points. One of the mounting points is the aforementioned through hole 611, another mounting point, namely, mounting hole 612 is shown in the figure, which may be used to mount a brake pipe assembly of the piggyback vehicle (not shown in the figure).

[0214] The stopping and driving beam assembly 63 may include a first connecting beam 631 which is hingedly arranged. One end of the first connecting beam 631 may be a first drive end 6311 for receiving an external driving force, and the other end may be a connecting end 6312. A first hinge shaft 633 of the first connecting beam 631 may be fixedly arranged, which specifically may be fixedly mounted at the support seat 61 and located between the first drive end 6311 and the connecting end 6312. The connecting end 6312 may be in transmission connection with the first stop beam 62.

[0215] Here, the embodiment of the present application does not limit the source of the driving force that the stopping and driving beam assembly 63 receives when unblocking, and a solution of manual driving may be employed. For example, an unblocking member such as an unblocking lever may be provided, when unblocking is required, the unlocking member may be manually operated by an operator, to apply the driving force to the first drive end 6311. Or, a solution of automatic driving may be employed; in this case, a power source may be a motor, an air cylinder, an oil cylinder, etc. The power source may be mounted on the vehicle body or on the ground equipment, which may be selected according to the actual situation. A transmission mechanism may further be provided between the power source and the first drive end 6311, to transmit the driving force of the power source.

[0216] In one solution, as shown in Figure 55 to Figure 57, the stopping and driving beam assembly 63 may further include a second connecting beam 632. One end of the second connecting beam 632 may be connected to the first stop beam 62 by screw connection or welding. One of the other end of the second connecting beam 632 and the connecting end 6312 may be provided with a second hinge shaft 634, the other one may be provided with a strip-shaped guide hole 631a-1, and the second hinge shaft 634 may be inserted into the strip-shaped guide hole 631a-1.

[0217] With this arrangement, by cooperation between the second hinge shaft 634 and the strip-shaped guide hole 631a-1, a rotational motion of the connecting end 6312 may be converted into a linear motion of the second connecting beam 632, and thus the first stop beam 62 may be driven to extend or retract.

[0218] In the drawings, the above strip-shaped guide hole 631a-1 may be provided in the connecting end 6312, and the second hinge shaft 634 may be fixed on the second connecting beam 632. In this way, the size of the second connecting beam 632 may be relatively small, which makes the structure more compact.

[0219] In specific implemention, the spring may have a certain pre-compression amount to ensure the reliability when the first stop beam 62 is at the stopping position. The adjustment of the pre-compression amount may be determined by the connection position between the second connecting beam 632 and the first stop beam 62.

[0220] For the solution that the second connecting beam 632 and the first stop beam 62 are fixed by screw connection, a first anti-loose member 624 may be further provided. The first anti-loose member 624 may also be connected to the first stop beam 62 and may tightly abut against the second connecting beam 632, to fix the second connecting beam 632 and prevent it from lossening. The first anti-loose member 624 may specifically be an anti-loose nut, and of course, it may also be an anti-loose stop limiting member in the form of an insertion bar, a stop block, or the like.

[0221] Further, a stop connecting plate 613 and a guard plate 614 may be provided. One end of the stop connecting plate 613 may be connected to the support seat 61, and the other end may be connected to the guard plate 614, so as to protect the stopping and driving beam assembly 63. The aforementioned first hinge shaft 633 may be mounted on the stop connecting plate 613, which may specifically mounted by welding, or may be mounted via a mounting plate 633a and bolts, as long as the first hinge shaft 633 is reliably fixed. In fact, the stop connecting plate 613 and the guard plate 614 may also be a part of the support seat 61.

[0222] In another solution, as shown in Figure 60 and Figure 61, the connecting end 6312 may be provided with a strip-shaped guide groove 631e. The first stop beam 62 may be inserted into the strip-shaped guide groove 631e, and

the connecting end 6312 may abut against a locking member 631f provided on the first stop beam 62, to define the connection position of the connecting end 6312 and the first stop beam 62.

[0223] With this arrangement, by cooperation between the first stop beam 62 and the strip-shaped guide groove 631e, the rotational movement of the connecting end 6312 may also be converted into the linear movement of the first stop beam 62, so as to drive the first stop beam 62 to perform unblocking or restore stopping.

[0224] In detail, the connecting end 6312 may be defined between the locking member 631f and the stop limiting member 65. The adjustment of the pre-compression amount of the third elastic piece 64 may be determined by a position where the locking member 631f is mounted on the first stop beam 62. A first gasket 631g may further be provided between the locking member 631f and the connecting end 6312, to reduce wear at the connection between the locking member 631f and the connecting end 6312.

[0225] The connection between the locking member 631f and the first stop beam 62 may be threaded connection, or welding, etc.. In case of threaded connection, a second anti-loose member may be further provided. The second anti-loose member may be an anti-loose nut, a stop insertion bar (not marked in the drawings), a stop block, etc., to limit the mounting position of the locking member 631f.

[0226] In comparison, both of the above two solutions can realize the conversion of the rotational motion of the first connecting beam 631 to the linear motion of the first stop beam 62, and thus can realize switching of the first stop beam 62 between the stopping state and the unblocking state. In specific implemention, those skilled in the art may make selections according to actual needs.

[0227] Taking the aforementioned first solution as an example, the first connecting beam 631 may include a long plate 631a and a short plate 631b that are spaced apart. The first hinge shaft 633 may be connected to the long plate 631a and the short plate 631b. One end of the long plate 631a forms the connecting end 6312, and the strip-shaped guide hole 631a-1 may be provided in the long plate 631a. A roller 631c may be connected between another end of the long plate 631a and the short plate 631b. In this case, the long plate 631a, the short plate 631b and the roller 631c are combined together to form the first drive end 6311.

[0228] When an external driving force acts on the roller 631c, the roller 631c may rotate, which may reduce the friction between the first drive end 6311 and the external drive device, and has a positive effect on reducing the wear of the first drive end 6311.

[0229] With reference to Figure 59, a roller shaft 631d may be further provided. The roller shaft 631d may include a rod portion 631d-1 and a head 631d-2. A radial size of the head 631d-2 may be larger than that of the rod portion 631d-1. Both the long plate 631a and the short plate 631b may be provided with a through hole 631b-1, and the through hole 631b-1 of one of the long plate 631a and the short plate 631b which is located at an inner side may be a stepped hole. In an assembled state, at least part of the head 631d-2 can be hidden in a large-diameter hole section of the stepped hole, and an end of the rod portion 631d-1 away from the head 631d-2 may cooperate with the locking nut 631d-3 for locking.

[0230] The "inner side" here refers to a side close to the end connecting hook 221. With this arrangement, a length of the roller shaft 631d protruding at the inner side may be shorter, which may greatly avoid the contact friction between the first drive end 6311 and the end connecting hook 221 when the first drive end 6311 rotates.

[0231] In the above solutions, the first stop beam 62 is restored for stopping mainly relies on the third elastic piece 64 that directly interacts with the first stop beam 62. In fact, in addition to this solution, the first stop beam 62 may also be driven by the stopping and driving beam assembly 63 to return to the stopping state. That is, both the unlocking and the stopping restoration of the first stop beam 62 may be completed by the stopping and driving beam assembly 63, and this solution may be realized by providing an elastic piece to the stopping and driving beam assembly 63.

[0232] In addition, a core of the above-mentioned transverse stop mechanism is the separation of the stopping and driving beam assembly 63 and the first stop beam 62. In the stopping state, only the first stop beam 62 and the support seat 61 are actually subjected to forces, and the stopping and driving beam assembly 63 for driving is not subjected to forces, which is a key point for the high reliability of the above-mentioned transverse stop mechanism.

[0233] The structure of a second type of transverse stop mechanism 6 may refer to Figure 62 to Figure 67. Figure 62 is a view showing relative positions among the second type of transverse stop mechanism, the end connecting hook, and the holding part in the stopping state; Figure 63 is a partially enlarged view of Figure 62; Figure 64 is a view showing relative positions among the second type of transverse stop mechanism, the end connecting hook, and the holding part in the unblocking state; Figure 65 is a partially enlarged view of Figure 64; Figure 66 is a structural view showing that the second type of transverse stop mechanism is mounted on the end connecting hook; and Figure 67 is an exploded view of Figure 66.

[0234] As shown in Figure 63 and Figure 65 to Figure 67, the transverse stop mechanism 6 includes a second stop beam 61' hingedly arranged. Two ends of the second stop beam 61' are a drive end 611' and a stop end 612', respectively. A hinge shaft 613' of the second stop beam 61' is located between the drive end 611' and the stop end 612', and the hinge shaft 613' is fixed to the end connecting hook 221; and a limiting beam 62' which is fixed to the end connecting hook 221. In the stopping state, the limiting beam 62' abuts against an outer side of the second stop beam 61' in the

transverse direction, and the second stop beam 61' is used to stop the holding part 4 in the transverse direction; in the unblocking state, the drive end 611' may rotate under a force, so as to drive the stop end 612' to release the stopping of the holding part 4.

[0235] With the above structure, in the stopping state, the limiting beam 62' abuts against the second stop beam 61' in the transverse direction, so as to provide a transverse support force for the second stop beam 61', and the second stop beam 61' stop the holding part 4 in the transverse direction, which can ensure accurate resetting of the holding part 4; while in the unblocking state, the drive end 611' may be subjected to a force and drive the whole second stop beam 61' to rotate, so as to drive the stop end 612' rotate to release the stopping, thereby not affecting normal separation between the holding part 4 and the end underframe 2.

[0236] More importantly, in the stopping state, when the holding part 4 is being reset and hits the second stop beam 61', only the stop end 612' and the limiting beam 62' are subjected to forces, and the drive end 611' serving as a moving portion of the transverse stop mechanism is not subjected to forces, which plays a key role in ensuring the reliability of the transverse stop mechanism.

[0237] It should be noted that the embodiment of the present application does not limit the source of the driving force that the drive end 611' receives when unblocking, and a solution of manual driving may be employed. For example, an unblocking member such as an unblocking lever may be provided, when unblocking is required, the unblocking component may be manually operated by an operator, to apply a driving force to the drive end 611'. Or, a solution of automatic drive may be employed; in this case, a power source may be a motor, a cylinder, an oil cylinder, etc. The power source may be mounted on the vehicle body or on the ground equipment, which may be selected according to the actual situation. A transmission mechanism may be further provided between the power source and the drive end 611' to transmit the driving force of the power source.

[0238] Further, a first limiting member 63' may be provided, and the first limiting member 63' is fixed to the end connecting hook 221. In the unblocking state, the second stop beam 61' may abut against the first limiting member 63', to avoid excessive rotation of the second stop beam 61'.

[0239] Here, the embodiment of the present application does not limit the shape of the first limiting member 63', which may be plate-shaped, block-shaped, column-shaped, etc., and may be specifically determined according to actual conditions. Similarly, the embodiment of the present application does not limit the number and mounting position of the first limiting member 63', as long as the above effects can be achieved. In an exemplary solution of the present application, the first limiting member 63' may be formed by extending the end hook wall plate 221c of the end connecting hook 221, in this way, there is no need to specially set the first limiting member 63', and the number of components may be reduced.

[0240] In the unblocking state, that is, when the second stop beam 61' abuts against the first limiting member 63', a center of gravity of the second stop beam 61' may deviate from the hinge shaft 613' in the longitudinal direction and be located at a side where the stop end 612' is located. In this way, when the driving force acting on the drive end 611' disappears, the second stop beam 61' may automatically rotate back to the stopping state under the action of its own gravity, other driving components are not required, and thus the structure of the equipment may be simpler.

[0241] And/or, a stop fourth elastic piece 65' is further provided. The stop fourth elastic piece 65' may act on the second stop beam 61', and a deformation amount of the stop fourth elastic piece 65' may be increased during the unblocking process, so as to gather an elastic force. When the driving force acting on the drive end 611' disappears, the elastic force accumulated by the stop fourth elastic piece 65' may be released, so as to drive, alone or in cooperation with the aforementioned gravity, the second stop beam 61' to rotate back to the stopping state.

[0242] The above-mentioned stop fourth elastic piece 65' may specifically be a torsion spring, which may be sleeved and mounted on the hinge shaft 613'. In two protruding ends of the torsion spring, one protruding end may be fixed (or abuts against a fixed component, such as the end connecting hook 221), and the other protruding end may abut against the second stop beam 61'. When the second stop beam 61' rotates to release the stopping state, the torsion spring may gather a torsional deformation force, and when the driving force acting on the drive end 611' disappears, the torsional deformation force may be released to drive the second stop beam 61' to rotate back automatically.

[0243] The above-mentioned stop fourth elastic piece 65' may also be a linear spring, for example, a spring element that generates an elastic force by axial displacement, such as a tension spring, a compression spring, etc.. Taking the solution in Figure 65 as an example, the linear spring may be a tension spring, one end of the tension spring may be fixed, and the other end of the tension spring may be connected with the second stop beam 61', so that an elastic force may be gathered when the second stop beam 61' rotates to release the stopping.

[0244] In addition to the above-mentioned torsion spring and linear spring, the stop fourth elastic piece 65' may also be an elastic element in the form of an elastic block, an elastic ball, a tension rope, etc., as long as the above technical effects can be achieved.

[0245] Furthermore, a second limiting member 64' may be provided, and the second limiting member 64' is fixed to the end connecting hook 221. In the stopping state, the second stop beam 61' may abut against the second limiting member 64', to limit the position of the second stop beam 61' in the stopping state. The limitation of the structure, number, and mounting position of the second limiting member 64' may be similar to the first limiting member 63', which will not

be described repeatedly here.

[0246] Moreover, with the support of the above second limiting member 64', the second stop beam 61' may be arranged to be vertically spaced apart from the limiting beam 62'. In this way, the limiting beam 62' does not need to bear the gravity of the second stop beam 61'. Correspondingly, no shear stress is generated at the connection between the limiting beam 62' and the end connecting hook 221, and thus the reliability of connection between the limiting beam 62' and the end connecting hook 221 may be higher.

[0247] With regard to the transverse stop mechanism 6 for the holding part 4 according to the above embodiments, the structure of the second stop beam 61' is further described in the following embodiments of the present application.

[0248] With reference to Figure 63, in the stopping state, the drive end 611' may be an end gradually inclined, from top to bottom, toward the stop end 612'. In this way, when the drive end 611' receives an upward driving force, the second stop beam 61' may naturally rotate in the direction for releasing the stopping state, so as to ensure that the second stop beam 61' can perform unlocking smoothly.

[0249] It may be understood that adjusting the shape of the drive end 611' is actually adjusting an acting direction of the driving force and the drive end 611'. In this way, in specific implementation, the rotationally unlocking of the second stop beam 61' may also be achieved by adjusting the direction of the driving force.

[0250] In addition, in the stopping state, an end of the second stop beam 61' away from the drive end 611' may be provided with a downward bending elbow. The elbow may serve as the stop end 612', and the arrangement of the elbow can improve the strength of the stop end 612'. Meanwhile, it can also avoid the vehicle body and brake pipe protective device (not shown in the figure).

[0251] With reference to Figure 67, the hinge shaft 613' of the second stop beam 61' may be a stepped shaft, which specifically may include a large diameter section 613a' and a small diameter section 613b'. The large diameter section 613a' may be used to connect with the end connecting hook 221, and the second stop beam 61' may be mounted on the large diameter section 613a'. A third limiting member 613c' may be further provided, the third limiting member 613c' may specifically be a nut, which may be mounted on the small diameter section 613b' to cooperate with the end connecting hook 221 to limit the mounting position of the second stop beam 61'. It should be understood that the third limiting member 613c' mainly functions for limiting instead of locking, it is necessary to ensure that the second stop beam 61' is able to rotate smoothly after the mounting is completed.

[0252] A second gasket 613d' may be further provided between the third limiting member 613c' and the second stop beam 61'. The second gasket 613d' may be made of rubber or metal, which may avoid direct friction between the second stop beam 61' and the third limiting member 613c', and has a positive effect on reducing wear.

Brake pipe protective device 10

[0253] A brake pipe is an important part of the railway vehicle, which is required to run through the vehicle body in the longitudinal direction when being mounted. For the piggyback vehicle, due to the repeated separation and installation between the holding part 4 and the body part 1, the brake pipe may interfere with the separation and installation of the holding part 4. Once interference occurs, the brake pipe may be damaged by the holding part 4 which is being moved.

[0254] For this reason, the present application further relates to a flip-type brake pipe protective device. The brake pipe protective device includes a protective housing and a brake pipe mounted at the protective housing. When the holding part is raised to be separated from the body part, the protective housing may flip outward about the transverse direction in the vertical plane, to avoid interference with the holding part 4. When the holding part 4 falls down to be mounted on the body part 1, the protective housing may flip inward about the transverse direction to return to the original position, so that the interference between the brake pipe and the holding part 4 which is being moved may be better avoided. Besides, the protective housing may also protect the brake pipe, abrasion and leakage caused by contact between the brake pipe and the ground can be prevented, which has a positive effect on the driving safety of the piggyback vehicle.

[0255] Specifically, please refer to Figure 68 to Figure 81, Figure 68 is a structural diagram of the brake pipe protective device; Figure 69 is an enlarged view showing a portion C in Figure 68; Figure 70 is an enlarged view showing a portion D in Figure 68; Figure 71 is an enlarged view showing a portion E in Figure 68; Figure 72 is a structural view showing the brake pipe protective device in a state where the holding part and the body part are connected; Figure 73 is an enlarged view of a portion inside a circle indicated in Figure 72; Figure 74 is a structural view showing the brake pipe protective device in a state where the holding part and the body part are separated; Figure 75 is an enlarged view a portion inside a circle indicated in Figure 74; Figure 76 is a structural view showing that a first protective limiting member and a second protective limiting member are arranged on the support seat; Figure 77 is a view showing the structure of a first pivotedly connected plate; Figure 78 is a view showing the structure of a second pivotedly connected plate; Figure 79 is a view showing the structure of a protective partition; Figure 80 is a view showing the structure of a pipe hanger seat plate; and Figure 81 is a view showing the structure of a pipe hanger connecting plate.

[0256] As shown in Figure 72, the body of a piggyback vehicle generally includes the body part 1 and the holding part

4, and the holding part 4 may be separated from the body part 1 by rotating the holding part 4 about the vertical direction or translating the holding part 4 in the transverse direction. The brake pipe is arranged on a transversely outer side of the holding part 4, when rotating the holding part 4 about the vertical direction or translating the holding part 4 in the transverse direction, in order to avoid the interference of the brake pipe, the holding part 4 is required to be lifted upward for a certain distance. In order to shorten the lifting distance and protect the brake pipe, a brake pipe protective device is provided according to the present application.

[0257] As shown in Figure 68, the brake pipe protective device 10 includes a protective housing 11, and the protective housing 11 has a housing cavity configured for accommodating the brake pipe. The protective housing 11 may protect the brake pipe on the one hand, and facilitate movement of the brake pipe as a whole on the other hand. As shown in Figure 72, when the holding part 4 is connected to the body part 1, the protective housing 11 is located on a transversely outer side of the side wall 42 of the holding part 4.

[0258] As shown in Figure 68, the brake pipe protective device 10 further includes a protective connecting member 12. As shown in Figure 69, the protective connecting member 12 includes a protective inner end 12a, a protective outer end 12b, and a protective adapting portion 12c located between the protective inner end 12a and the protective outer end 12b. As shown in Figure 73, the protective inner end 12a is located at a lower side of the holding part 4 and abuts against the holding part 4, which specifically may abut against the pressing plate 412d of the holding part 4; the protective outer end 12b is located at the transversely outer side of the protective inner end 12a, and is rotatably connected with the body part 1, which specifically may be rotatably connected with the support seat 61 of the body part 1.

[0259] As shown in Figure 73, during the process of connecting the holding part 4 and the body part 1, a pressing force of the holding part 4 against the protective inner end 12a gradually increases, so that the protective inner end 12a is subjected to a force which gradually becomes greater than the gravity of the protective outer end 12b. At this time, the protective connecting member 12 rotates around a position where it is rotatably connected with the body part 1 (the direction as shown by the arrow in the figure), thereby driving the protective housing 11 to rotate upward and inward, so that the protective housing 11 is reset and finally reaches the position shown in Figure 73.

[0260] As shown in Figure 75, in the process of separating the holding part 4 from the body part 1, the pressing force of the holding part 4 against the protective inner end 12a is gradually reduced, so that the protective inner end 12a is subjected to a force which gradually becomes smaller than the gravity of the protective outer end 12b, at this time, under the action of gravity, the protective connecting member 12 rotates around the position where it is rotatably connected with the body part 1 (the direction as shown by the arrow in the figure), so as to drive the protective housing 11 to rotate downward and outward, thereby making the height position of the protective housing 11 be lowered and finally reaches the position shown in Figure 75. Here, when mounting the brake pipe protective device 10, the position of its center of gravity may be adjusted so that its center of gravity is distributed on a transversely outer side of its rotational center. In this way, once the connection between the brake pipe protective device 10 and the holding part 4 is released, the above-mentioned rotation can be performed.

[0261] Since the height position of the protective housing 11 is lowered, the interference between the protective housing 11 and the holding part 4 may be avoided by lifting the holding part 4 upward only for a small distance, so that the holding part 4 may smoothly rotate around the vertical direction or translate along the transverse direction.

[0262] In summary, during the process of separating the holding part 4 and the body part 1, the protective housing 11 is able to automatically rotate downward and outward to avoid the holding part 4, which effectively reduces the lifting distance of the holding part 4; and during the process of connecting the holding part 4 and the body part 1, the protective housing 11 may is able to automatically reset. With the reduction of the lifting distance and the automatic avoidance and automatic reset of the protective housing 11, the separation efficiency and connection efficiency between the holding part 4 and the body part 1 are improved.

[0263] Further, the brake pipe protective device 10 may be provided with a first protective limiting member 13 (see Figure 73 and Figure 76). The first protective limiting member 13 is fixed to the body part 1, which specifically may be fixed on the support seat 61. When the protective housing 11 rotates downward and outward to an extreme position, the protective connecting member 12 abuts against the first protective limiting member 13, which prevents the risk that the protective housing 11 may be difficult to reset caused by excessive downward rotation. In the figure, the first protective limiting member 13 is a block, while in actual implementation, its structure and shape may be adjusted as required, which is not limited to the block.

[0264] Further, the brake pipe protective device 10 may be provided with a magnetic member 14 (see Figure 68). When the protective housing 11 is located at the transversely outer side of the holding part 4, the protective housing 11 is magnetically attracted to the side wall 42 of the holding part 4 via the magnetic member 14. In this way, vibration of the brake pipe protective device casued by vibration of the vehicle can be alleviated, and thus the service life of the brake pipe protective device 10 is improved.

[0265] In the solution shown in the figure, the magnetic member 14 is detachably fixed on an upper surface of the protective housing 11, which specifically may be fixed by bolts and nuts. By fixing the magnetic member 14 on the upper surface of the protective housing 11, it is ensured that a direction of a magnetic force subjected by the protective housing

11 is substantially consistent with a resetting direction of the protective housing 11 during the resetting process of the protective housing 11, so that the magnetic force may assist the resetting of the protective housing 11. The magnetic member 14 and the protective housing 11 are detachably fixed, which facilitates the replacement of the magnetic member 14.

[0266] Furthermore, the brake pipe protective device 10 may be provided with a second protective limiting member 15 (see Figure 75 and Figure 76). When the protective housing 11 is reset to the transversely outer side of the holding part 4, the protective connecting member 12 abuts against the second protective limiting member 15. In the case that the magnetic member 14 is provided, when the holding part 4 moves upward, under the action of the magnetic force, the protective connecting member 12 has a tendency to move upward accordingly. By providing the second protective limiting member 15, the protective connecting member 12 may be prevented from moving upward with the holding part 4. In the figure, the second protective limiting member 15 is a block, while in actual implementation, its structure and shape may be adjusted as required, which is not limited to the block.

[0267] In the solution shown in the figure (see Figure 69), the protective connecting member 12 includes a first pivotedly connected plate 121, a second pivotedly connected plate 122, and a pivoting shaft 123. The first pivotedly connected plate 121 and the second pivotedly connected plate 122 are spaced apart in the longitudinal direction. As shown in Figure 73, the second pivotedly connected plate 122 is closer to the holding part 4 than the first pivotedly connected plate 121. The support seat 61 is located between the first pivotedly connected plate 121 and the second pivotedly connected plate 122. The pivoting shaft 123 passes through the first pivotedly connected plate 121, the mounting hole 612 in the support seat 61 and the second pivotedly connected plate 122 in sequence to connect the three together, thus realizing the rotational connection between the protective connecting member 12 and the body part 1. This structure has high connection reliability. Of course, in actual implementation, it is not limited to this structure.

[0268] In the solution shown in the figure, one end of the pivoting shaft 123 is provided with a limiting head (not visible in the figure), and the other end is provided with a radial hole, and a limiting pin 1231 is inserted into the radial hole. The first pivotedly connected plate 121 and the second pivotedly connected plate 122 are located between the limiting head and the limiting pin 1231. In this way, the pivoting shaft 123 is axially limited, and thus the reliability of the connection between the protective connecting member 12 and the body part 1 can be further improved.

[0269] In the solution shown in the figure, the protective connecting member 12 further includes a protective roller 125, and the protective roller 125 is rotatably connected to the second pivotedly connected plate 122. As shown in Figure 73, the second pivotedly connected plate 122 extends to a lower side of the pressing plate 412d, so that an outer peripheral surface of the protective roller 125 abuts against a lower surface of the pressing plate 412d, thereby the protective connecting member 12 and the holding part 4 abut against each other. By providing the protective roller 125, the wear during the abutting process of the protective connecting member 12 and the holding part 4 can be alleviated.

[0270] In the solution shown in the figure (see Figure 69), a fixed shaft 124 is provided. One end of the fixed shaft 124 is fixed to the second pivotedly connected plate 122, which specifically may be fixed by welding, and the other end of the fixed shaft 124 is fixedly provided with a retaining ring (not shown in the figure). The protective roller 125 is rotatably sleeved on a periphery of the fixed shaft 124 and is located between the retaining ring and the second pivotedly connected plate 122. The retaining ring and the second pivotedly connected plate 122 can prevent the protective roller 125 from being separated from the fixed shaft 124.

[0271] In the solution shown in the figure (see Figure 68 and Figure 69), a front end and a rear end of the protective housing 11 are not provided with end plates. The front end and the rear end of the protective housing 11 are each blocked by the protective connecting member 12, which is beneficial to weight reduction of the brake pipe protective device 10. In detail, the front end of the protective housing 11 is blocked by one first pivotedly connected plate 121 and one second pivotedly connected plate 122, and the rear end of the protective housing 11 is blocked by another first pivotedly connected plate 121 and another second pivotedly connected plate 122. Each one of the first pivotedly connected plates 121 and the second pivotedly connected plates 122 is provided with a protective through hole 12d for the brake pipe to pass through. In the figure (see Figure 77 and Figure 78), the first pivotedly connected plate 121 and the second pivotedly connected plate 122 are each provided with two protective through holes 12d, and the two protective through holes 12d are arranged along an up and down direction and are staggered with each other. In actual implementation, the number and arrangement of the protective through holes 12d are not limited to this.

[0272] In the solution shown in the figure (see Figure 68), the protective housing 11 includes a C-shaped protective beam 111, multiple protective blocking plates 112, and multiple sets of pipe hanger assemblies 113. The protective blocking plates 112 are fixed at an open side of the C-shaped beam for blocking, which specifically may be fixed by welding. The protective blocking plates 112 are spaced apart in a length direction (i.e., a longitudinal direction) of the C-shaped protective beam 111, so that mounting openings are formed between adjacent protective blocking plates 112, and the mounting openings are used for mounting the pipe hanger assemblies 113.

[0273] Specifically, as shown in Figure 70 and Figure 71, each set of pipe hanger assembly 113 includes two protective partitions 1131 and two pipe hanger seat plates 1132. The two protective partitions 1131 are fixed inside the C-shaped protective beam 111, which specifically may be fixed by welding, and the two protective partitions 1131 are spaced apart

from each other in the length direction (i.e., the longitudinal direction) of the C-shaped protective beam 111. The two pipe hanger seat plates 1132 are fixed to the two protective partitions 1131 in one-to-one correspondence and are located between the two protective partitions 1131. In addition, in Figure 71, a pipe hanger connecting plate 1133 is further provided.

[0274] Specifically, as shown in Figure 79, the protective partition 1131 is provided with a pipe hole for the brake pipe to pass through, and the brake pipe sequentially passes through the pipe hole on each protective partition 1131. In this way, wobble of the brake pipe in the protective housing 11 may be reduced, which is beneficial to improving the protection effect and alleviate the vibration in driving.

[0275] Specifically, as shown in Figure 80, the pipe hanger seat plate 1132 is provided with a seat hole for threaded fasteners to pass through. As shown in Figure 81, the pipe hanger connecting plate 1133 is provided with connecting holes for threaded fasteners to pass through. In Figure 70, the seat holes of the two pipe hanger seat plates 1132 are aligned so that the threaded fasteners pass through the two pipe hanger seat plates 1132 in sequence. In Figure 71, the connecting holes in the pipe hanger connecting plate 1133 is aligned with the seat holes in the pipe hanger seat plate 1132, so that the threaded fasteners pass through the pipe hanger connecting plate 1133 and the pipe hanger seat plate 1132 in sequence.

[0276] In the solution shown in the figure (see Figure 68), there are three sets of pipe hanger assemblies 113. The pipe hanger assemblies 113 on both sides have the same structure (the structure shown in Figure 70), and compared with the pipe hanger assemblies 113 on both sides, the intermediate pipe hanger assembly is further provided with one pipe hanger connecting plate 1133.

[0277] A section of the brake pipe 20 located in the protective housing 11 is a rigid pipe, and a pipe section located outside the protective housing 11 is a flexible pipe. Two ends of the rigid pipe are in communication with two flexible pipes respectively. A flange connector 201 is provided at one end of the flexible pipe which is in communication with the rigid pipe, and the flexible pipe is fixed to the brake pipe protective device 10 via the flange connector 201. In a specific solution, the first pivotedly connected plate 121 is provided with a flange connection hole, and the flange connector 201 is fixed on the first pivotedly connected plate 121 (see Figure 73). This kind of brake pipe can adapt to frequent turning of the protective housing 11, which is not easy to break and has high reliability.

[0278] Specifically, the rigid pipe may be a whole pipe, or may be formed by connecting multiple rigid pipe sections through flanges or quick-fitting joints. Each flexible pipe may be a whole pipe, or it may be formed by connecting multiple flexible pipe sections through flanges or quick couplers.

[0279] A piggyback vehicle is further provided according to the present application, including a vehicle body, and the vehicle body is the vehicle body of the piggyback vehicle according to the above embodiments.

[0280] Since the vehicle body of the piggyback vehicle has the above technical effects, the piggyback vehicle with the vehicle body should also have similar technical effects, which are not described in detail herein.

[0281] It may be understood that in addition to the vehicle body, the piggyback vehicle may further include a bogie, a saddle, a coupler, a coupler buffer device, a braking system, etc., which are all components that a piggyback vehicle should have in the conventional technology. The structures of these components are not described in detail in the present application. In specific practice, those skilled in the art may select components with suitable structures for use according to actual needs.

[0282] The above embodiments are only preferred embodiments of the present application. It should be noted that, for those skilled in the art, other improvements and modifications may be further made without departing from the principle of the present application, and these improvements and modifications should also be deemed as falling into the protection scope of the present application.

Claims

1. A vehicle body of a piggyback vehicle, comprising a body part (1) and a holding part (4), each of two longitudinal ends of the holding part (4) is provided with a connection structure, wherein

   the connection structure comprises an upper hook (421) and a lower circular shaft (412c) extending in a transverse direction; and
   the body part (1) is provided with an end connecting mechanism (22), the end connecting mechanism (22) comprises an end connecting hook (221) and an end longitudinal support member (222), and an upward hook opening is defined by the end connecting hook (221); in an assembled state, the lower circular shaft (412c) is hung on the hook opening of the end connecting hook (221), and the upper hook (421) is clamped onto the end longitudinal support member (222).

2. The vehicle body of the piggyback vehicle according to claim 1, wherein

a clamping face, where the upper hook (421) is clamped to the body part, of the upper hook (421) comprises a top face section (421a) and two side face sections (421b);
in the two side face sections (421b), a first side face section is a vertical face, and a second side face section is an inclined face which is inclined from top to bottom in a direction away from the first side face section; or, each one of the two side face sections (421b) is an inclined face which is inclined from top to bottom in a direction away from the other one.

3. The vehicle body of the piggyback vehicle according to claim 2, wherein each of the two side face sections (421b) is provided with a holding part wear plate (421c), and a shear-resisting stop structure is provided between the holding part wear plate (421c) and the side face section (421b).

4. The vehicle body of the piggyback vehicle according to claim 1, wherein

the holding part (4) comprises a bottom wall (41) and two side walls (42) connected to the bottom wall (41), and each of two longitudinal ends of each of the two side walls (42) is provided with the upper hook (421); and
the side wall (42) is further provided with a guide limiting member (422) configured for cooperating with a limiting guide member of the body part (1), to guide the mounting of the holding part (4) and limit the holding part (4) in the transverse direction.

5. The vehicle body of the piggyback vehicle according to claim 4, wherein

the bottom wall (41) comprises an intermediate wall body (411) and an end wall body (412) located at each of two longitudinal sides of the intermediate wall body (411), the end wall body (412) comprises a main body portion (412a) and a connecting portion (412b), and the main body portion (412a) employs a box structure; the lower circular shaft (412c) is mounted at an end of the main body portion (412a) away from the intermediate wall body (411); and
the intermediate wall body (411) comprises two longitudinal beams (411a) spaced apart in the transverse direction, and the two longitudinal beams (411a) are connected by a plurality of transverse beams (411b) spaced apart in a longitudinal direction; and wherein
each of the longitudinal beams (411a) comprises a flat beam section (411a-1) and a grid beam section (411a-2), and the flat beam section (411a-1) comprises a flat plate (411a-1a) and a plurality of reinforcing beams (411a-1b) mounted at a bottom of the flat plate (411a-1a); the grid beam section (411a-2) comprises a plurality of small crossbars (411a-2a) spaced apart in the longitudinal direction.

6. The vehicle body of the piggyback vehicle according to claim 5, wherein

the intermediate wall body (411) is further provided with a longitudinal positioning structure; and/or,
the intermediate wall body (411) is further provided with a rotation center insertion connection portion (411b-1); and/or,
the bottom wall (41) is further provided with a connection mounting position (412a-1); and/or,
the bottom wall (41) further comprises an inclined wall body (413) gradually inclined upward from inside to outside, the inclined wall body (413) is located at each of two transverse sides of the intermediate wall body (411) and is configured to connect the intermediate wall body (411) and the side wall (42).

7. The vehicle body of the piggyback vehicle according to any one of claims 1 to 6, wherein an inner hook face of the end connecting hook (221) is provided with an end groove (221a) extending in the transverse direction, an inner surface of the end groove (221a) forms an end guide face configured to guide the lower circular shaft (412c) to slide in, and the end guide face is also configured to cooperate with the lower circular shaft (412c), to guide the holding part (4) and the body part (1) to be separated from each other in a rotational manner.

8. The vehicle body of the piggyback vehicle according to any one of claims 1 to 6, wherein the end longitudinal support member (222) comprises an end longitudinal support body (222a) and an end wear plate (222b) fixed at each of a front end and a rear end of the end longitudinal support body (222a), the end longitudinal support body (222a) is configured for the upper hook (421) to hook onto, and in a hooking state, the end wear plate (222b) at the front end abuts against a front side of an inner hook face of the upper hook (421), and the end wear plate (222b) at the rear end abuts against a rear side of the inner hook face of the upper hook (421).

9. The vehicle body of the piggyback vehicle according to any one of claims 1 to 6, wherein the end connecting

mechanism (22) further comprises an end transverse limiting member (223); and wherein
the end transverse limiting member (223) is located above the end connecting hook (221) and in front of the end longitudinal support member (222); the end transverse limiting member (223) comprises an end transverse limiting groove (223a), the end transverse limiting groove (223a) is configured to cooperate with the guide limiting member (422) of the holding part (4), to guide the mounting of the holding part (4) and limit the holding part (4) in the transverse direction.

10. The vehicle body of the piggyback vehicle according to claim 7, wherein

the body part (1) is further provided with a locking mechanism (5) configured for locking or unlocking the holding part (4) in an up and down direction; and/or,
the body part (1) is further provided with a transverse stop mechanism (6); in a stopping state, the transverse stop mechanism (6) is used to stop the holding part (4) in the transverse direction; in an unblocking state, the transverse stop mechanism (6) is used to release the stopping of the holding part (4).

11. The vehicle body of the piggyback vehicle according to claim 10, wherein

the end connecting hook (221) comprises an end hook body (221b), the end hook body (221b) comprises two end hook sub-bodies (221b-1) spaced apart in the transverse direction and an end accommodation cavity (221b-2) formed between the two end hook sub-bodies (221b-1), and the locking mechanism (5) is mounted in the end accommodation cavity (221b-2); and/or,
the transverse stop mechanism (6) is mounted on a transversely outer side of the end connecting hook (221).

12. The vehicle body of the piggyback vehicle according to claim 11, wherein the locking mechanism (5) comprises:

a first lock body (51), wherein the first lock body (51) is hinged with the end connecting hook (221), one end of the first lock body (51) is a locking end (511), another end of the first lock body (51) is a first limiting end (512), and a third hinge shaft (52) of the first lock body (51) is located between the locking end (511) and the first limiting end (512);
a first limiting portion (53), wherein the first limiting portion (53) is fixed in the end accommodation cavity (221b-2); and
a first locking and driving beam assembly (54) connected with the first lock body (51); and wherein
in a locked state, the first limiting end (512) abuts against the first limiting portion (53) from top to bottom, the locking end (511) abuts against the holding part (4), to lock the holding part (4); in an unlocked state, the first locking and driving beam assembly (54) is configured to drive the first limiting end (512) to be disengaged from the first limiting portion (53) from bottom to top, and the locking end (511) to rotate to be separated from the holding part (4).

13. The vehicle body of the piggyback vehicle according to claim 12, wherein the first locking and driving beam assembly (54) comprises a first push beam (541), a first guide sleeve (542) and a transmission beam (543); wherein the first guide sleeve (542) is fixed in the end accommodation cavity (221b-2), the first push beam (541) is slidably connected to the first guide sleeve (542), and the transmission beam (543) has one end hinged with the first lock body (51) and another end hinged with the first push beam (541).

14. The vehicle body of the piggyback vehicle according to claim 13, further comprising a first elastic piece (541b), wherein one end of the first elastic piece (541b) interacts with the first push beam (541), and an unlocking process is a process in which a deformation amount of the first elastic piece (541b) increases.

15. The vehicle body of the piggyback vehicle according to claim 12, wherein the locking mechanism (5) further comprises a second limiting portion (55), and the second limiting portion (55) is fixed in the end accommodation cavity (221b-2); the first lock body (51) further comprises a second limiting end (514), and in the locked state, the second limiting end (514) abuts against the second limiting portion (55) from bottom to top.

16. The vehicle body of the piggyback vehicle according to claim 11, wherein the locking mechanism (5) comprises:

a lock head (51'), wherein the lock head (51') is rotatably connected to the end connecting hook (221), and the lock head (51') is provided with a locking portion (511') and a support portion (512') at two sides of its rotational center line respectively;

a second lock body (52'), wherein the second lock body (52') is slidably connected to the end connecting hook (221); and

a second locking and driving assembly (53') in transmission connection with the second lock body (52'); and wherein

in a locked state, the second lock body (52') supports the support portion (512') from bottom to top, to make the locking portion (511') press the holding part (4); in an unlocked state, the second locking and driving assembly (53') is allowed to drive the second lock body (52') to displace in a direction away from the lock head (51'), and the support portion (512') is allowed to rotate downward about the rotational center line, to make the locking portion (511') rotate upward to be separated from the holding part (4).

17. The vehicle body of the piggyback vehicle according to claim 16, wherein the second locking and driving assembly (53') comprises a second push beam (531'), a second guide sleeve (532')and a connecting beam unit (533'); wherein the second guide sleeve (532') is fixed in the end accommodation cavity (221b-2), the second push beam (531') is slidably connected to the second guide sleeve (532'), and the connecting beam unit (533') has one end of hinged with the second push beam (531') and another end hinged with the second lock body (52').

18. The vehicle body of the piggyback vehicle according to claim 17, further comprising a second elastic piece (531b'), wherein one end of the second elastic piece (531b') interacts with the second push beam (531'), and an unlocking process is a process in which a deformation amount of the second elastic piece (531b') increases.

19. The vehicle body of the piggyback vehicle according to claim 17, wherein the locking mechanism (5) further comprises a rotary support body (54'), and the rotary support body (54') is fixed to the end connecting hook (221); the rotary support body (54') is provided with a rotary shaft portion (541'), the rotary shaft portion (541') has an arc-shaped cylindrical surface, the lock head (51') is provided with an arc-shaped notch (513') that matches the rotary shaft portion (541'), the lock head (51') is inserted into the rotary shaft portion (541') through the arc-shaped notch (513'), and a central axis of the rotary shaft portion (541') serves as the rotational center line of the lock head (51').

20. The vehicle body of the piggyback vehicle according to claim 16, wherein

a center of gravity of the lock head (51') deviates from the rotational center line in the longitudinal direction and is located at a side where the support portion (512') is located; and/or,

the vehicle body of the piggyback vehicle further comprises a third elastic piece, and a locking process is a process in which a deformation amount of the third elastic piece increases.

21. The vehicle body of the piggyback vehicle according to claim 11, wherein the transverse stop mechanism (6) comprises:

a support seat (61), wherein the support seat (61) is fixed to the end connecting hook (221), and the support seat (61) is provided with a through hole (611) ;

a first stop beam (62); and

a stopping and driving beam assembly (63) which is in transmission connection with the first stop beam (62); and wherein

in a stopping state, the first stop beam (62) extends out of the through hole (611) to stop the holding part (4) in the transverse direction; in an unblocking state, the stopping and driving beam assembly (63) is used to drive the first stop beam (62) to retract, to release the stopping of the holding part (4).

22. The vehicle body of the piggyback vehicle according to claim 21, further comprising a fourth elastic piece (64), wherein the fourth elastic piece (64) acts on the first stop beam (62), and an unblocking process is a process in which a deformation amount of the elastic piece (64) increases.

23. The vehicle body of the piggyback vehicle according to claim 21, wherein the stopping and driving beam assembly (63) comprises a first connecting beam (631) which is hingedly arranged, one end of the first connecting beam (631) is a first stopping and driving end (6311), and another end is a connecting end (6312); the first connecting beam (631) is fixedly arranged with a first hinge shaft (633) and is located between the first stopping and driving end (6311) and the connecting end (6312); the connecting end (6312) is in transmission connection with the first stop beam (62).

24. The vehicle body of the piggyback vehicle according to claim 11, wherein the transverse stop mechanism (6) comprises:

a second stop beam (61') which is hingedly arranged, wherein two ends of the second stop beam (61') are a second stopping and driving end (611') and a stop end (612') respectively; a hinge shaft (613') of the second stop beam (61') is located between the second stopping and driving end (611') and the stop end (612'), and the hinge shaft (613') is fixed to the end connecting hook (221); and

a limiting beam (62'), wherein the limiting beam (62') is fixed to the end connecting hook (221); and wherein in a stopping state, the limiting beam (62') abuts against an outer side of the second stop beam (61') in the transverse direction, and the second stop beam (61') is used to stop the holding part (4) in the transverse direction; in an unblocking state, the second stopping and driving end (611') is rotated under a force, to drive the stop end (612') to release the stopping of the holding part (4).

25. The vehicle body of the piggyback vehicle according to claim 24, wherein the transverse stop mechanism (6) further comprises a first limiting member (63') and a second limiting member (64'), wherein the first limiting member (63') and the second limiting member (64') are both fixed to the end connecting hook (221); in an unblocking state, the second stop beam (61') abuts against the first limiting member (63'); while in a stopping state, the second stop beam (61') abuts against the second limiting member (64').

26. The vehicle body of the piggyback vehicle according to claim 11, wherein the end connecting hook (221) further comprises an end hook wall plate (221c) covering an outer hook face of the end hook body (221b), wherein the end hook wall plate (221c) is provided with an end first connecting hole (221d), and the end first connecting hole (221d) is in communication with the end accommodation cavity (221b-2), to allow an unlocking member to extend into the end accommodation cavity (221b-2) through the end first connecting hole (221d) to unlock the locking mechanism.

27. The vehicle body of the piggyback vehicle according to any one of claims 1 to 6, further comprising a brake pipe protective device (10), wherein the brake pipe protective device (10) comprises:

a protective housing (11), wherein the protective housing (11) has a housing cavity configured for accommodating a brake pipe, and the protective housing (11) is located at a transversely outer side of the holding part (4) when the holding part (4) and the body part (1) of the piggyback vehicle are connected; and

a protective connecting member (12) having a protective inner end (12a) located at a lower side of the holding part (4), a protective outer end (12b) located at a transversely outer side of the protective inner end (12a), and a protective adapting portion (12c) located between the protective inner end (12a) and the protective outer end (12b); and wherein

the protective inner end (12a) abuts against the holding part (4), the protective outer end (12b) is fixedly connected to the protective housing (11), the protective adapting portion (12c) is rotatably connected with the body part (1); during a process of separating the holding part (4) and the body part (1), the protective connecting member (12) is allowed to rotate under gravity to drive the protective housing (11) to rotate outward, and in a process of connecting the holding part (4) and the body part (1), the protective connecting member (12) is allowed to rotate under pressing of the holding part (4) to drive the protective housing (11) to be reset to the transversely outer side of the holding part (4).

28. The vehicle body of the piggyback vehicle according to claim 27, wherein the protective connecting member (12) comprises a first pivotedly connected plate (121), a second pivotedly connected plate (122) and a pivoting shaft (123), wherein the first pivotedly connected plate (121) and the second pivotedly connected plate (122) are spaced apart in a longitudinal direction, and the second pivotedly connected plate (122) is closer to the holding part (4) than the first pivotedly connected plate (121); the pivoting shaft (123) passes through the first pivotedly connected plate (121), the body part (1) and the second pivotedly connected plate (122) in sequence to connect the three together.

29. The vehicle body of the piggyback vehicle according to claim 28, wherein the protective connecting member (12) further comprises a protective roller (125), and the protective roller (125) is rotatably connected to the second pivotedly connected plate (122); and the second pivotedly connected plate (122) extends to the lower side of the holding part (4), to make an outer peripheral surface of the protective roller (125) abuts against a lower surface of the holding part (4).

30. The vehicle body of the piggyback vehicle according to claim 27, wherein the brake pipe protective device further comprises a first protective limiting member (13), and the first protective limiting member (13) is fixed to the body part (1); when the protective housing (11) rotates downward and outward to reach an extreme position, the protective connecting member (12) abuts against the first protective limiting member (13).

31. The vehicle body of the piggyback vehicle according to claim 27, wherein the brake pipe protective device further comprises a magnetic member (14), and when the protective housing (11) is located at the transversely outer side of the holding part (4), the protective housing (11) is magnetically attracted to the holding part (4) via the magnetic member (14).

32. The vehicle body of the piggyback vehicle according to any one of claims 1 to 6, wherein

the body part (1) comprises two end underframes (2), a bogie is provided under each of the two end underframes (2), and each of the two end underframes (2) is provided with the end connecting mechanism (22), the number of the holding part (4) is one, and the holding part (4) is mounted between the two end underframes (2); or,
the body part (1) comprises two end underframes (2) and a joint underframe (3), the joint underframe (3) comprises two joint underframe sub-portions (3a), the two joint underframe sub-portions (3a) are connected by a joint and are located between the two end underframes (2); a bogie is provided under each of the two end underframes (2), and the two joint underframe sub-portions (3a) share another bogie underneath, and the number of the holding part (4) is two, each of the two holding parts (4) is mounted between the corresponding end underframe (2) and the corresponding joint underframe sub-portion (3a) which are adjacent to each other.

33. A piggyback vehicle, comprising a vehicle body, wherein the vehicle body is the vehicle body according to any one of claims 1 to 32.

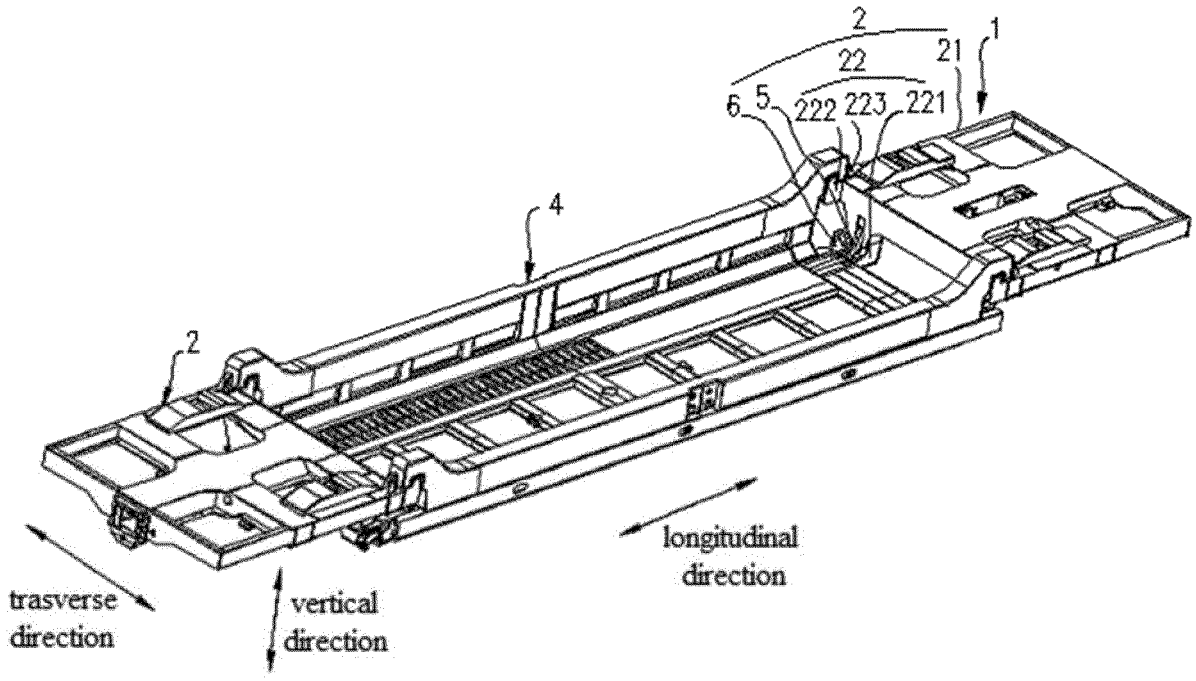


Figure 1

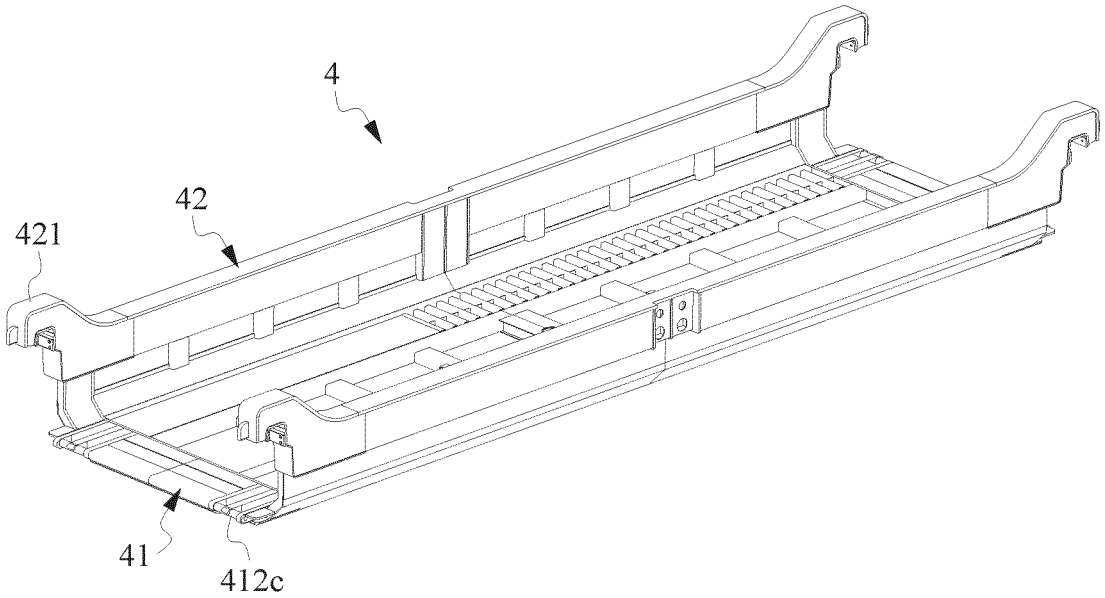


Figure 2

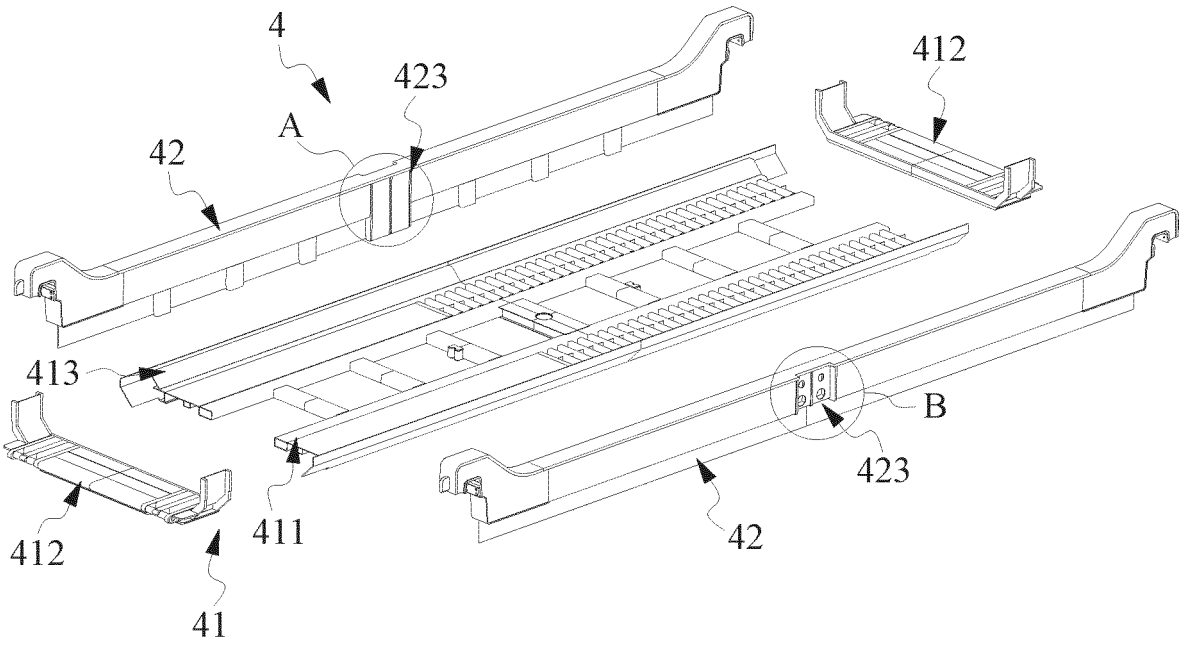


Figure 3

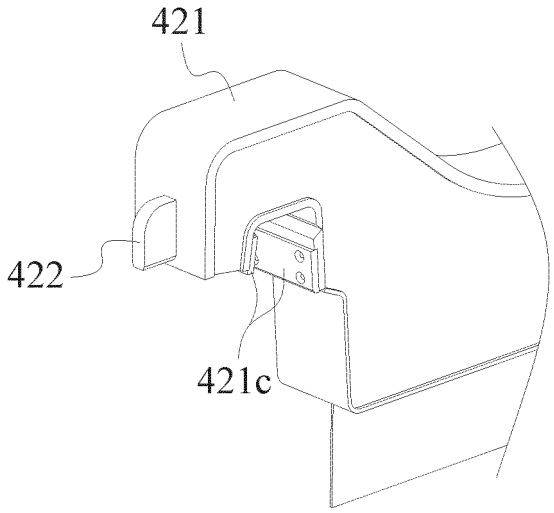


Figure 4

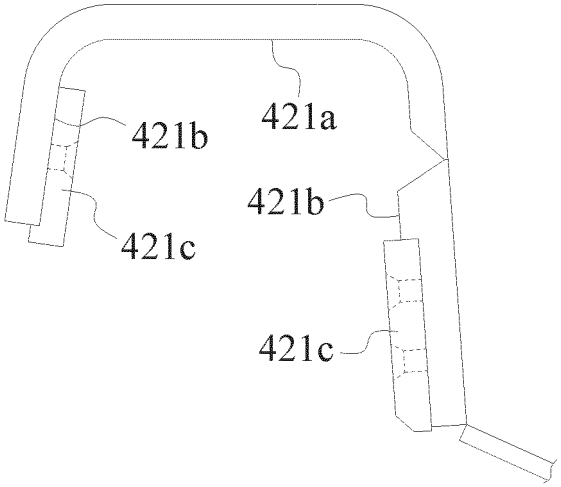


Figure 5

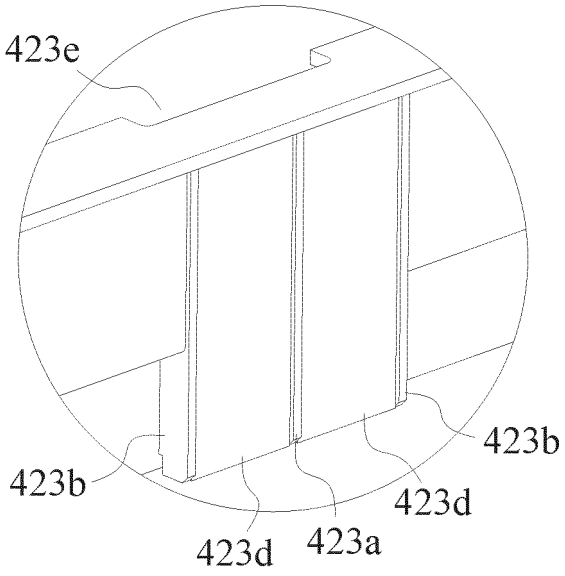


Figure 6

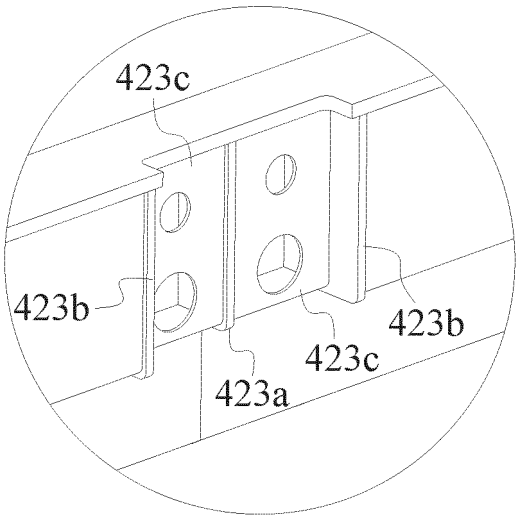


Figure 7

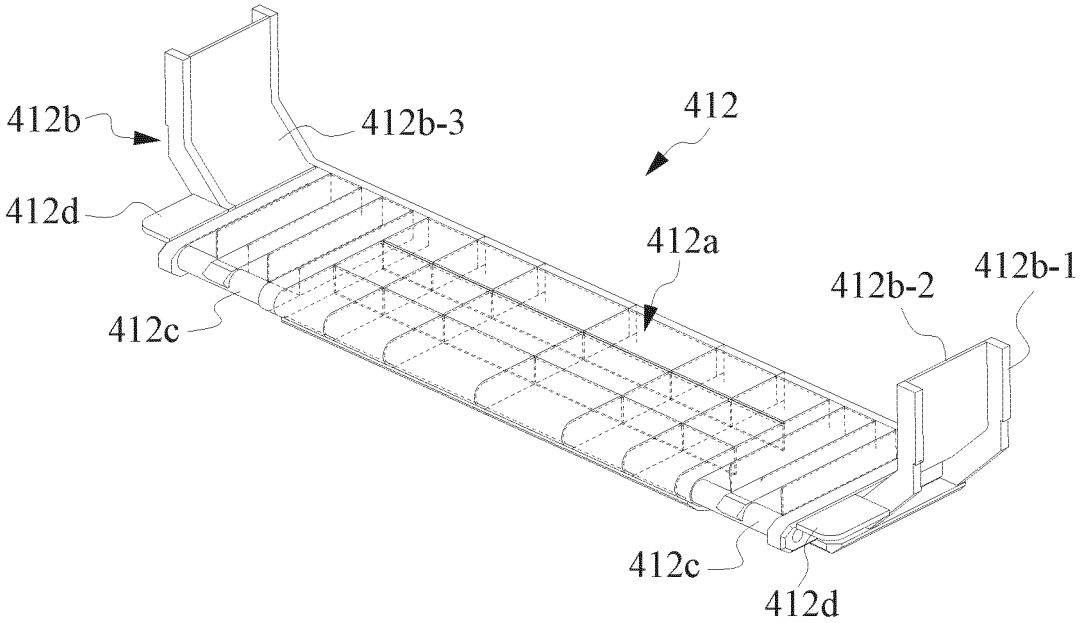


Figure 8

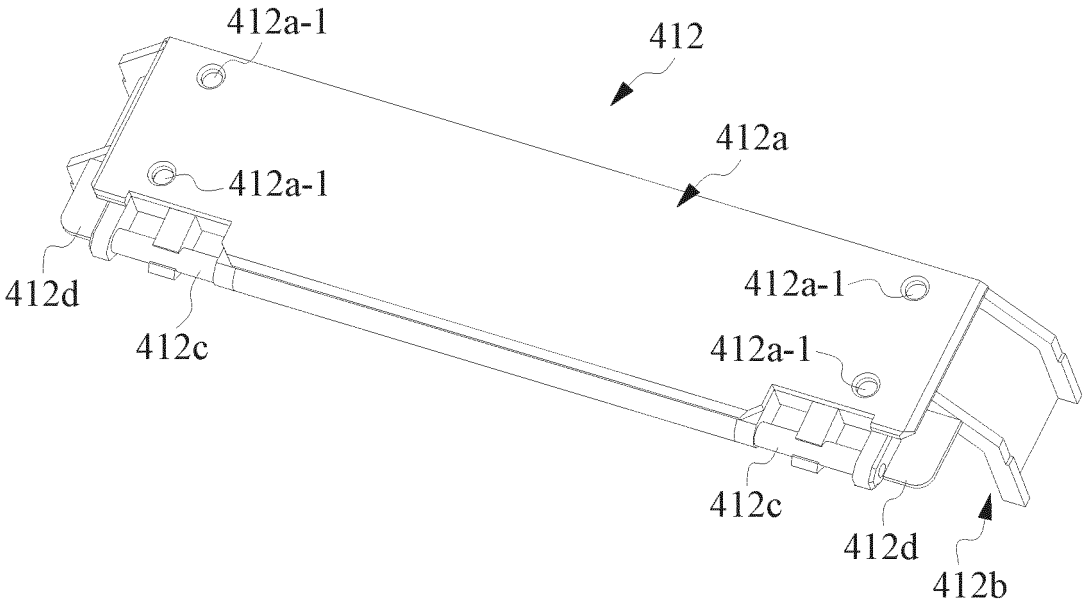


Figure 9

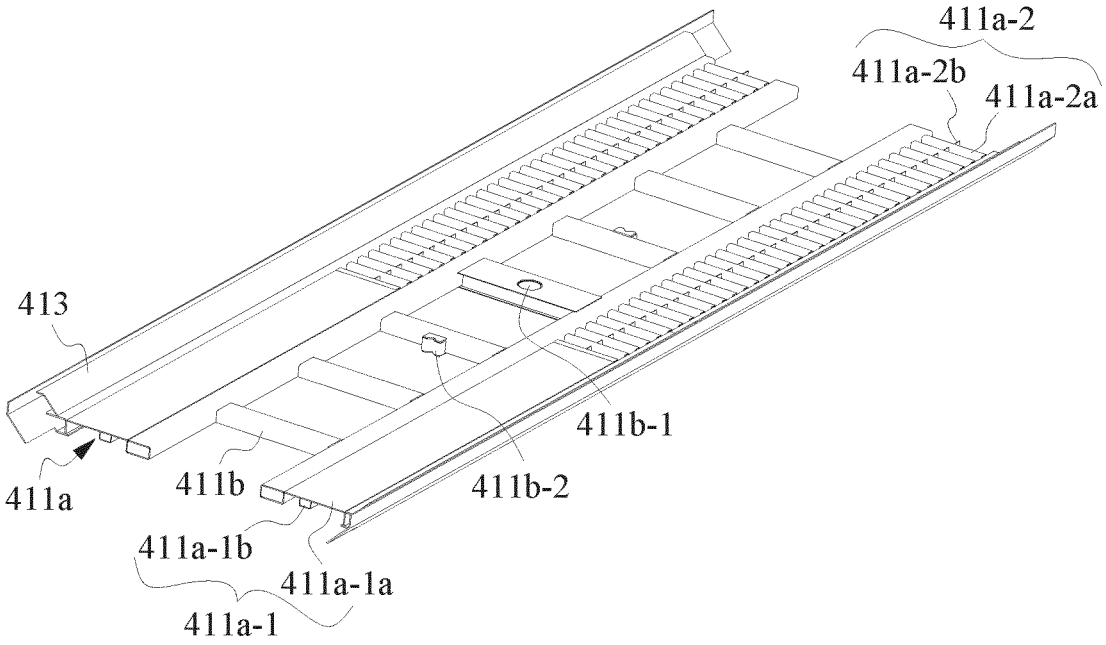


Figure 10

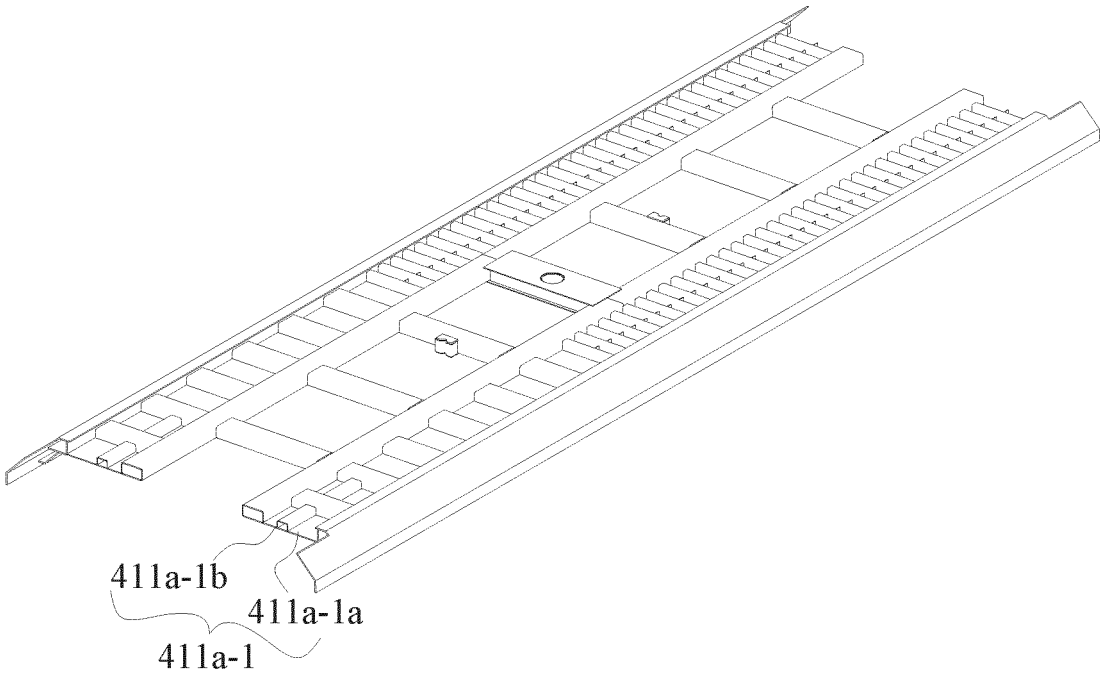


Figure 11

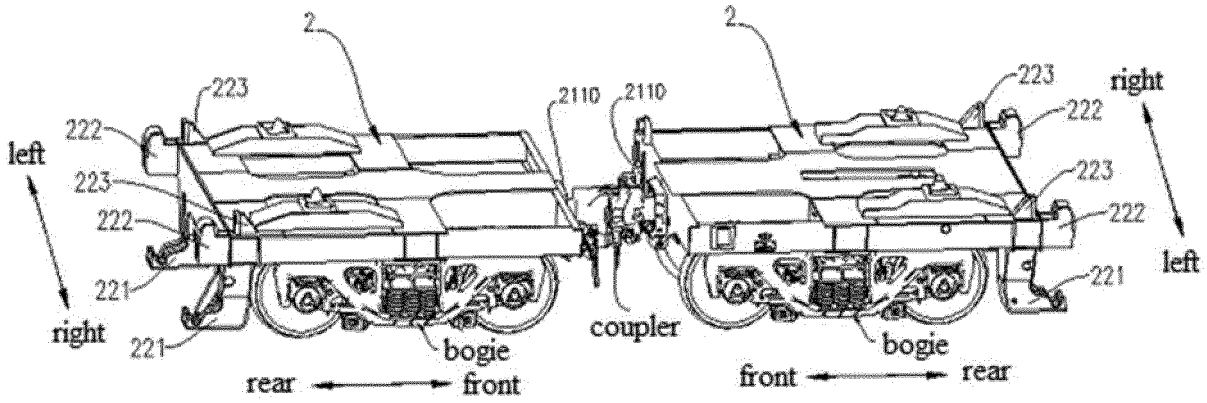


Figure 12

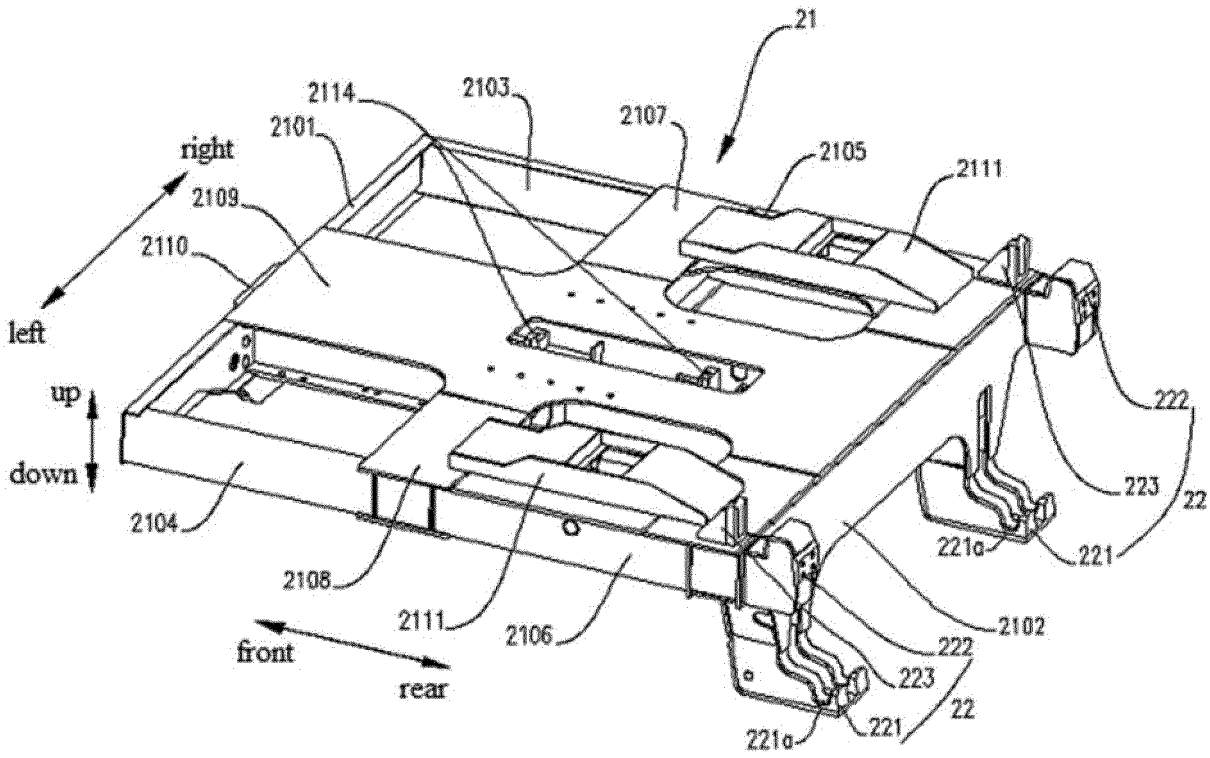


Figure 13

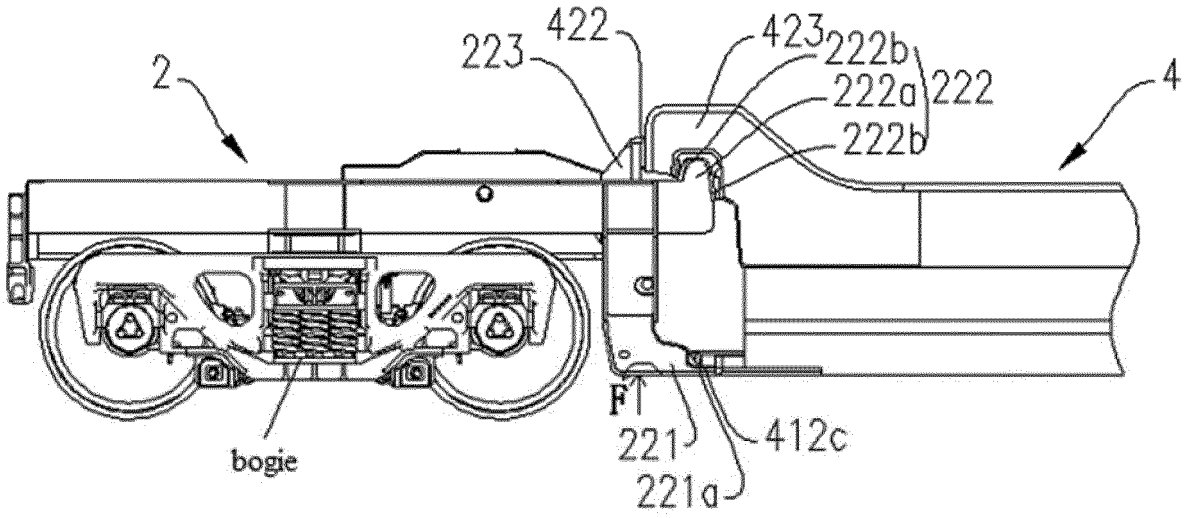


Figure 14

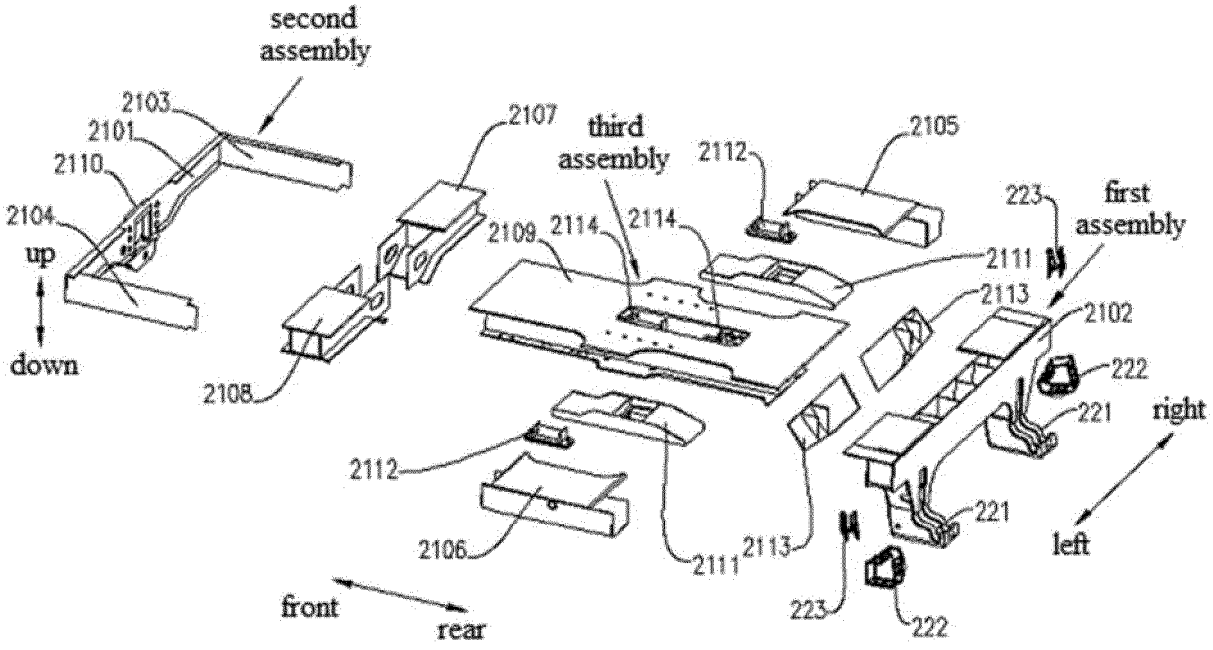


Figure 15

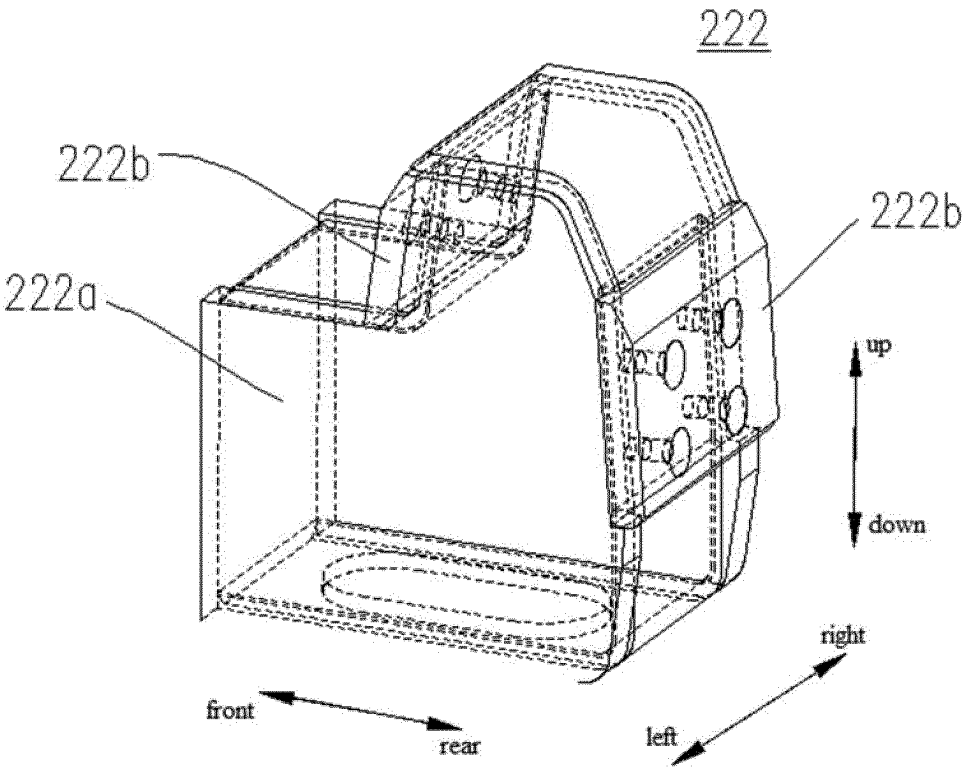


Figure 16

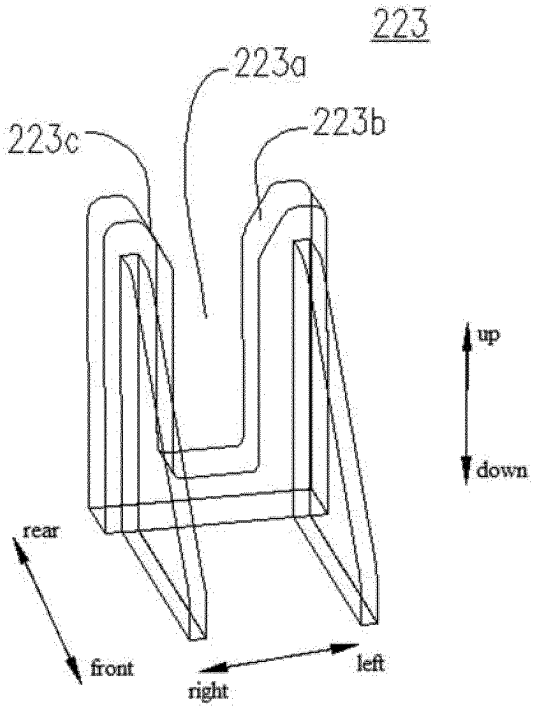


Figure 17

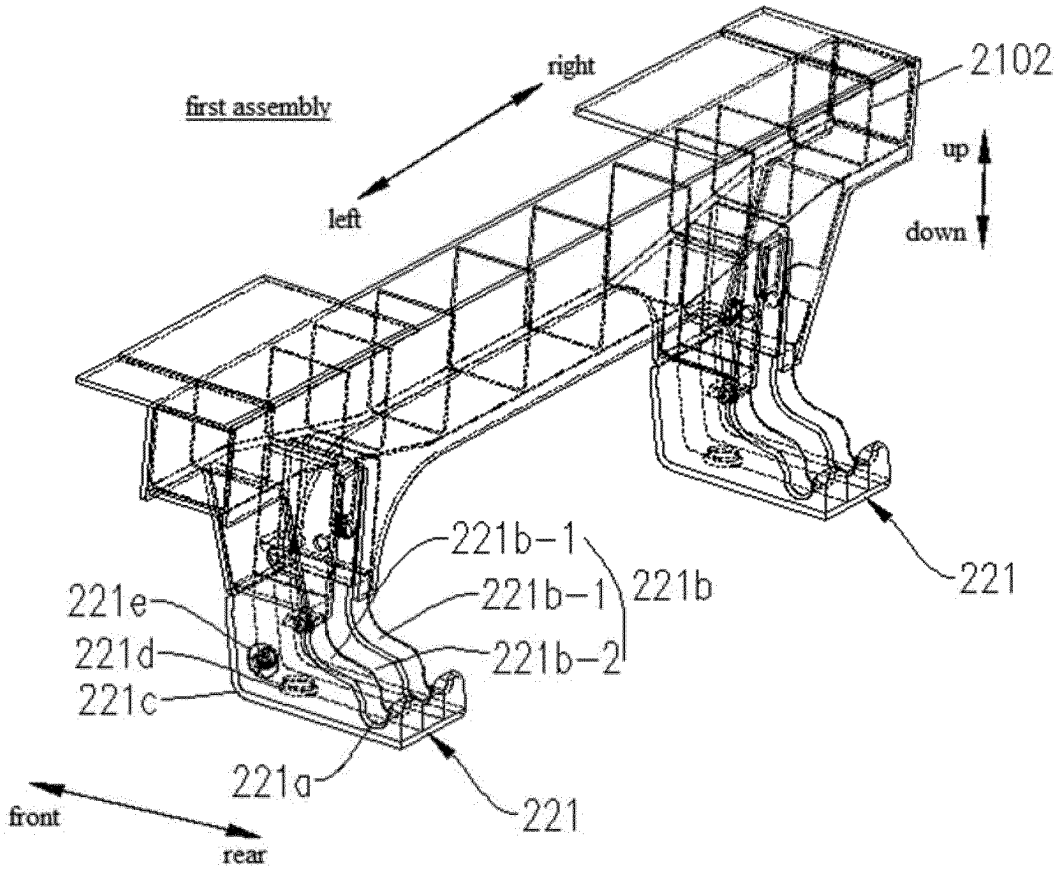


Figure 18

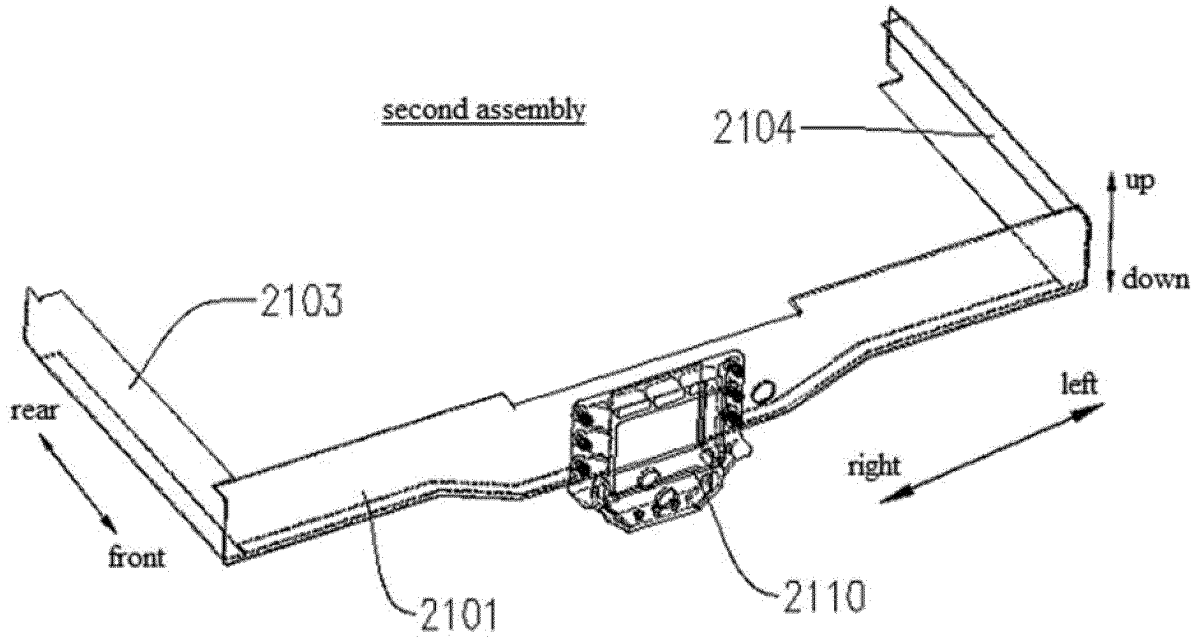


Figure 19

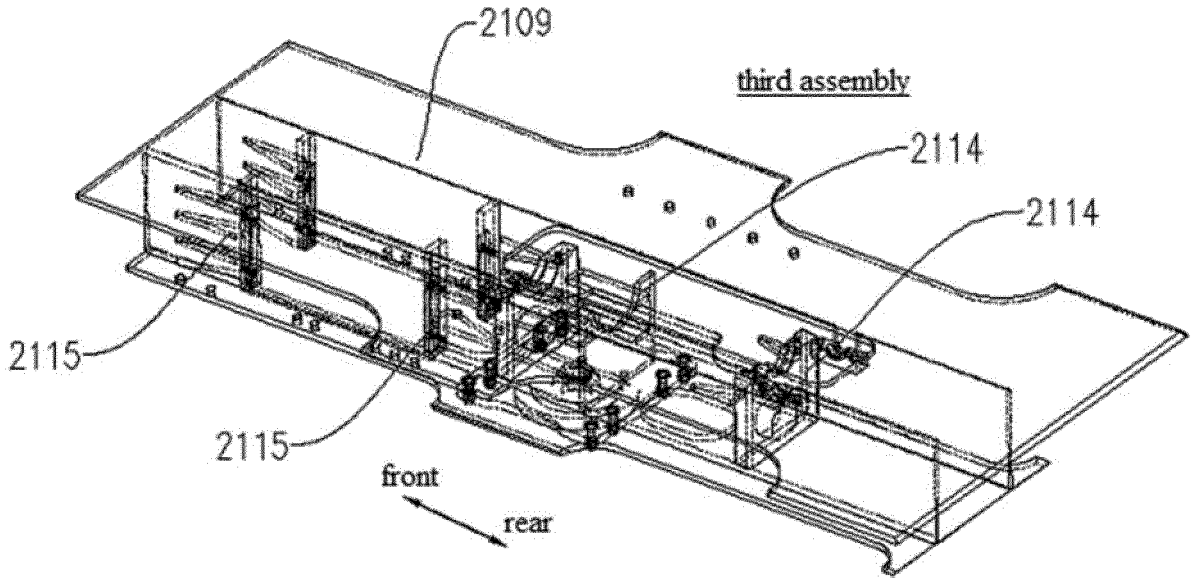


Figure 20

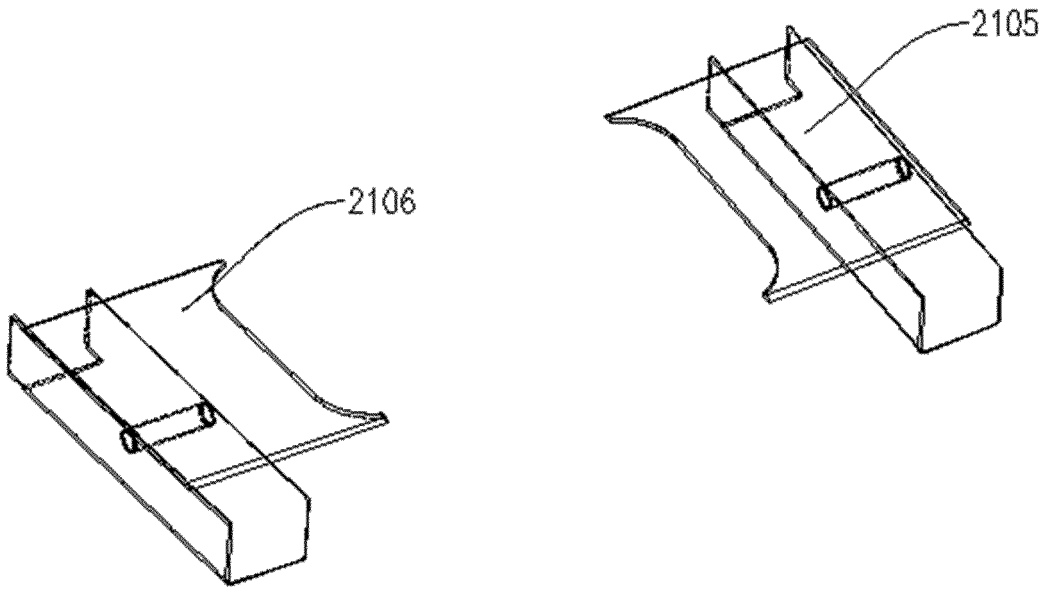


Figure 21

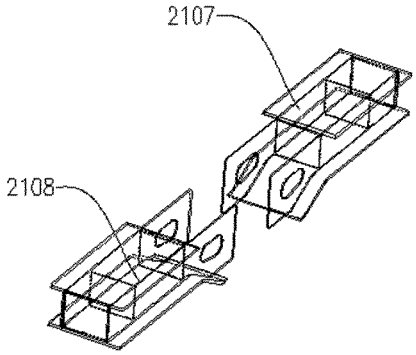


Figure 22

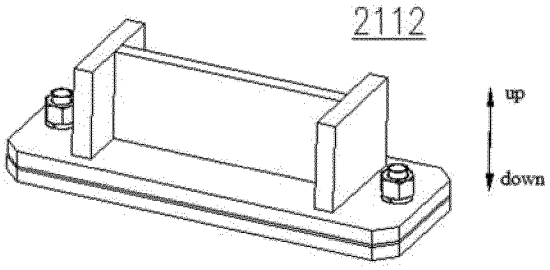


Figure 23

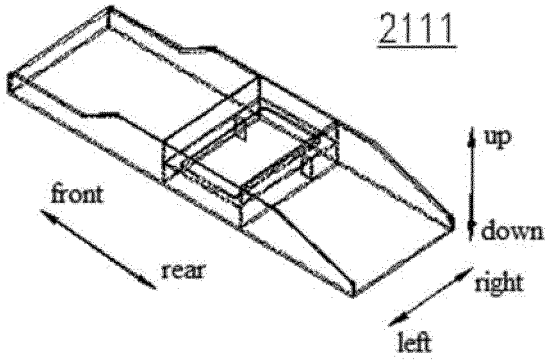


Figure 24

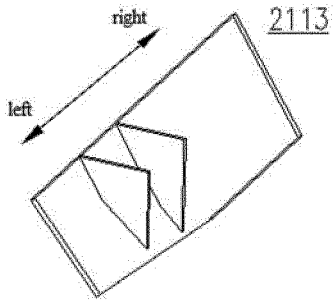


Figure 25

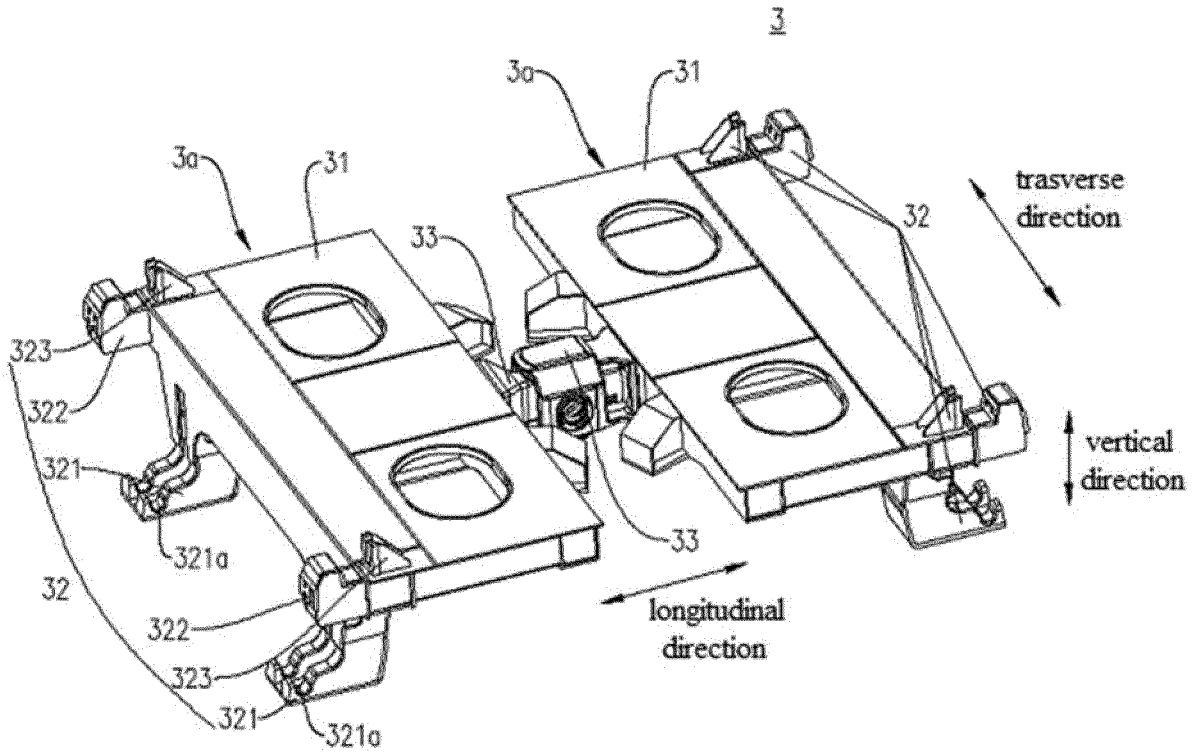


Figure 26

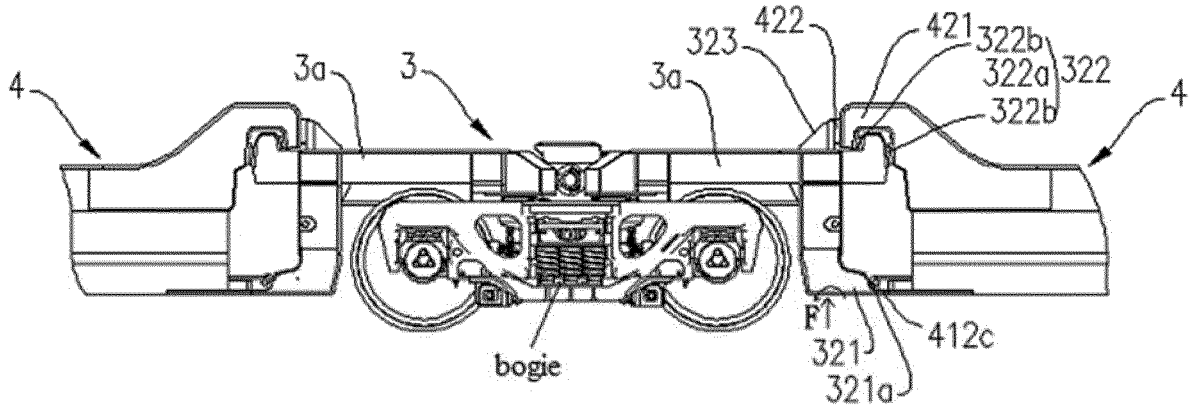
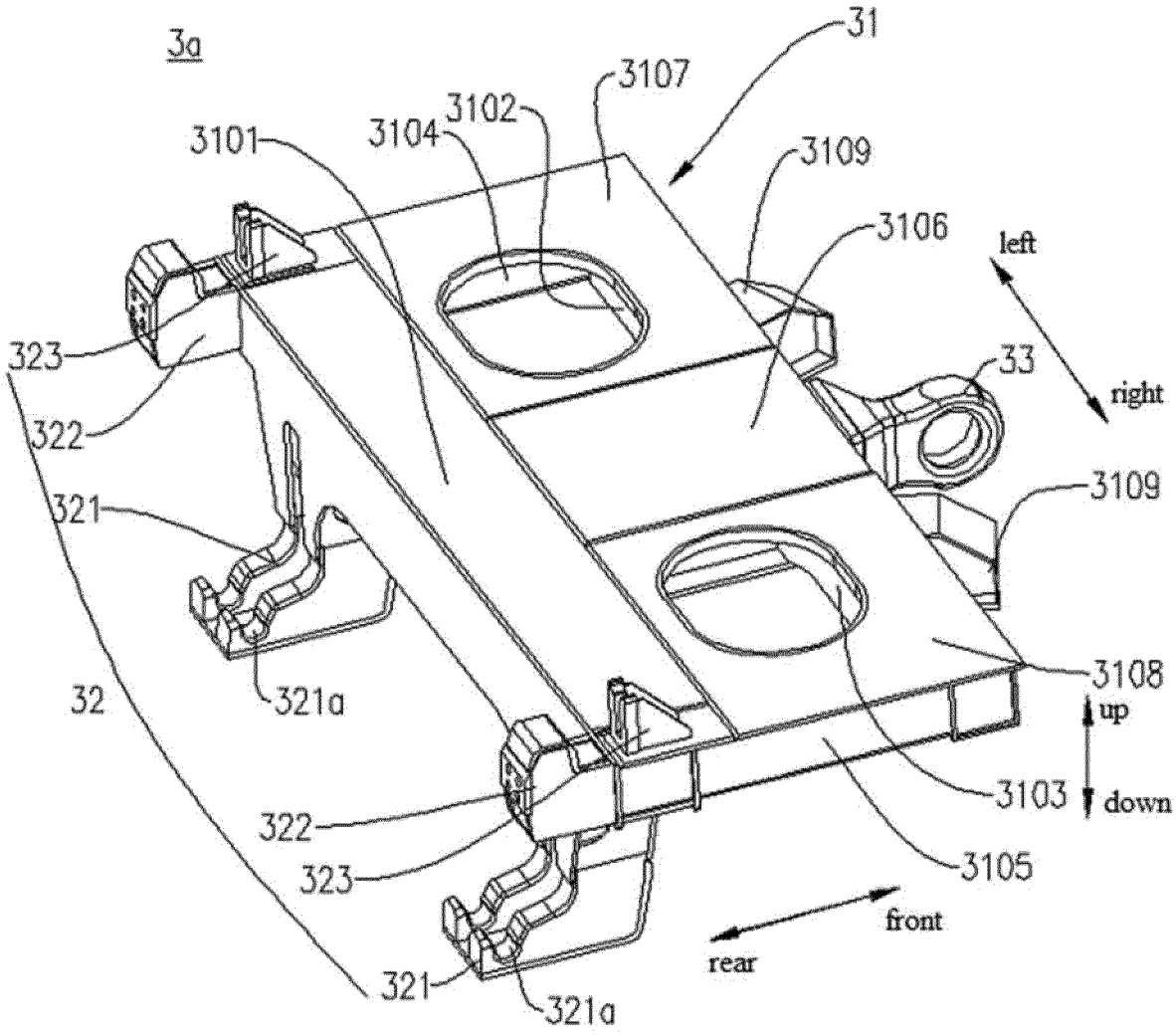


Figure 27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front
rear
321
321a

Figure 28

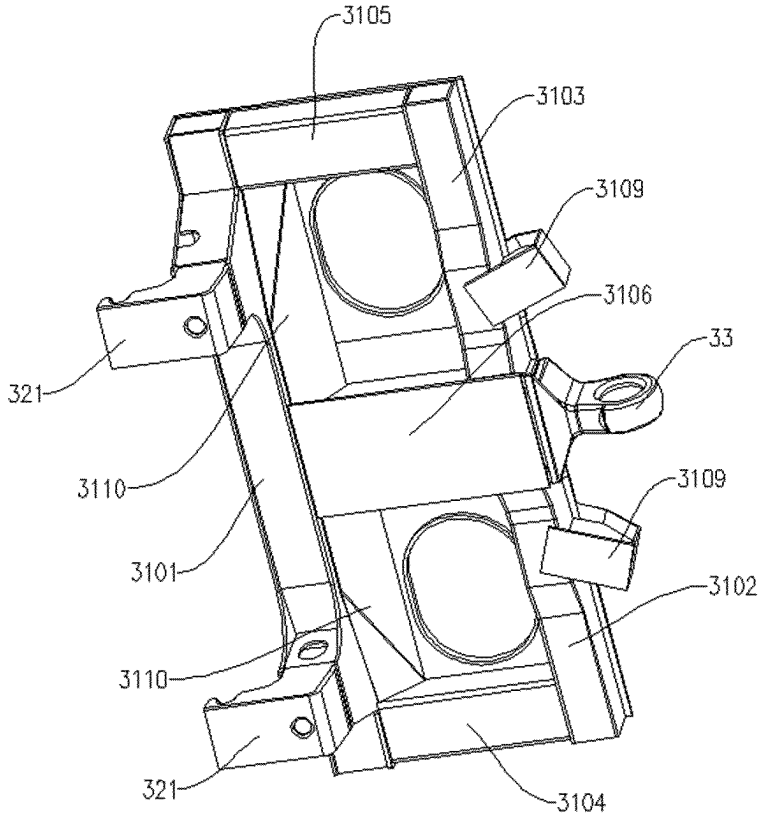


Figure 29

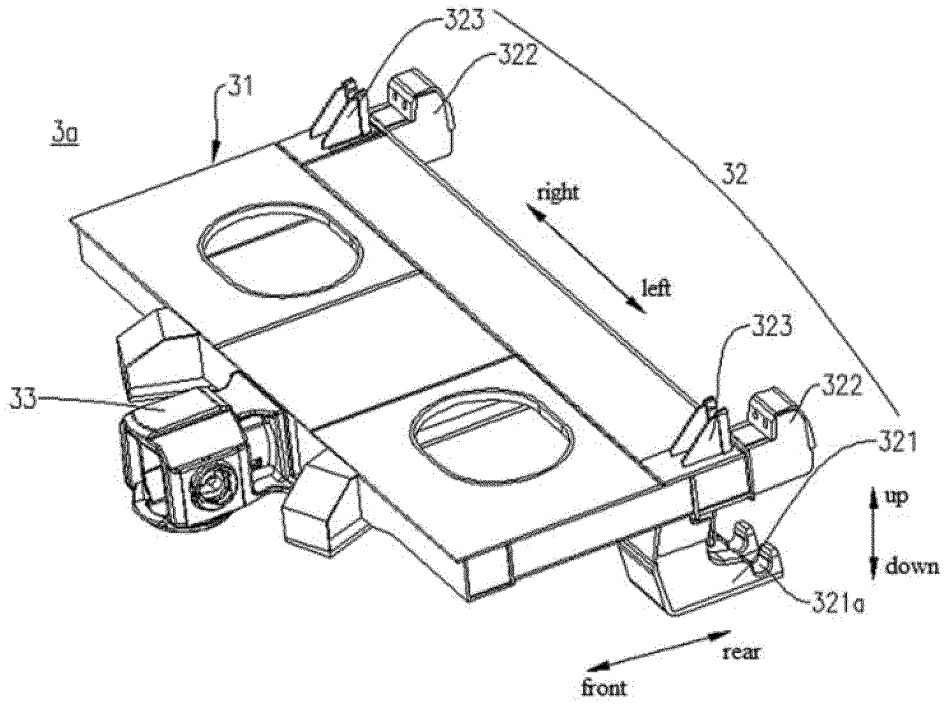
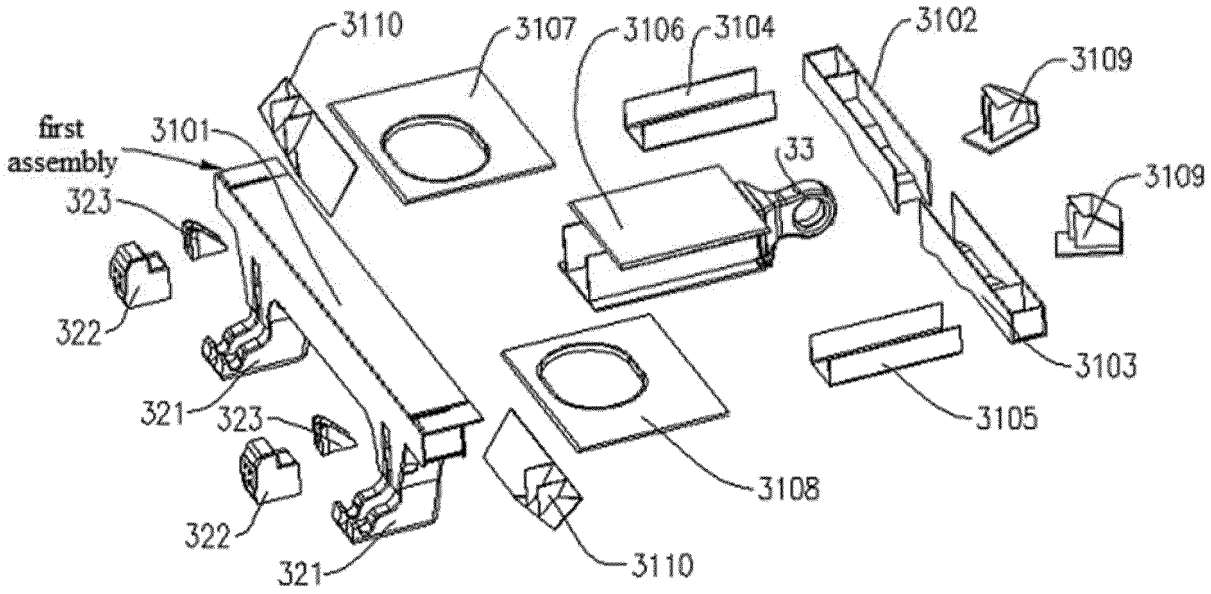


Figure 30



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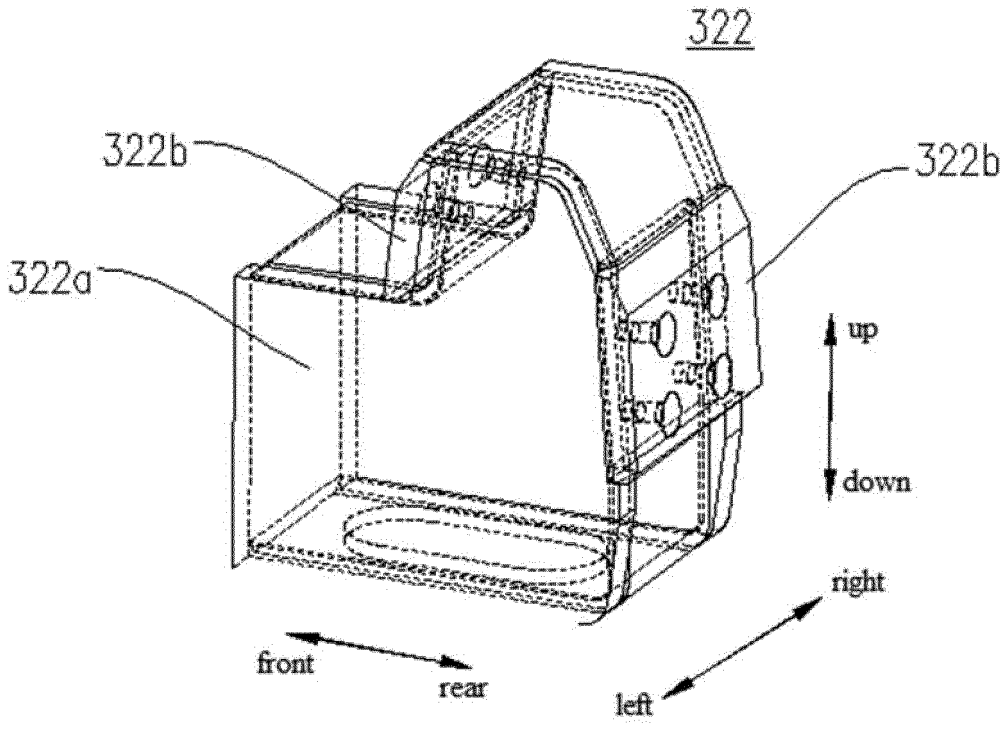

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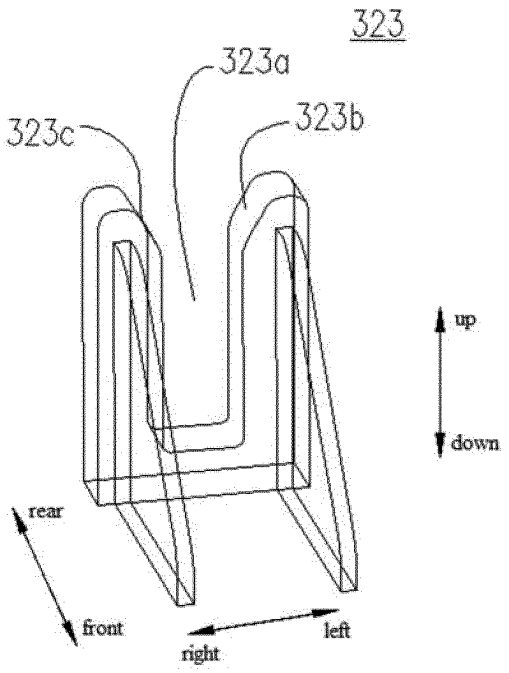

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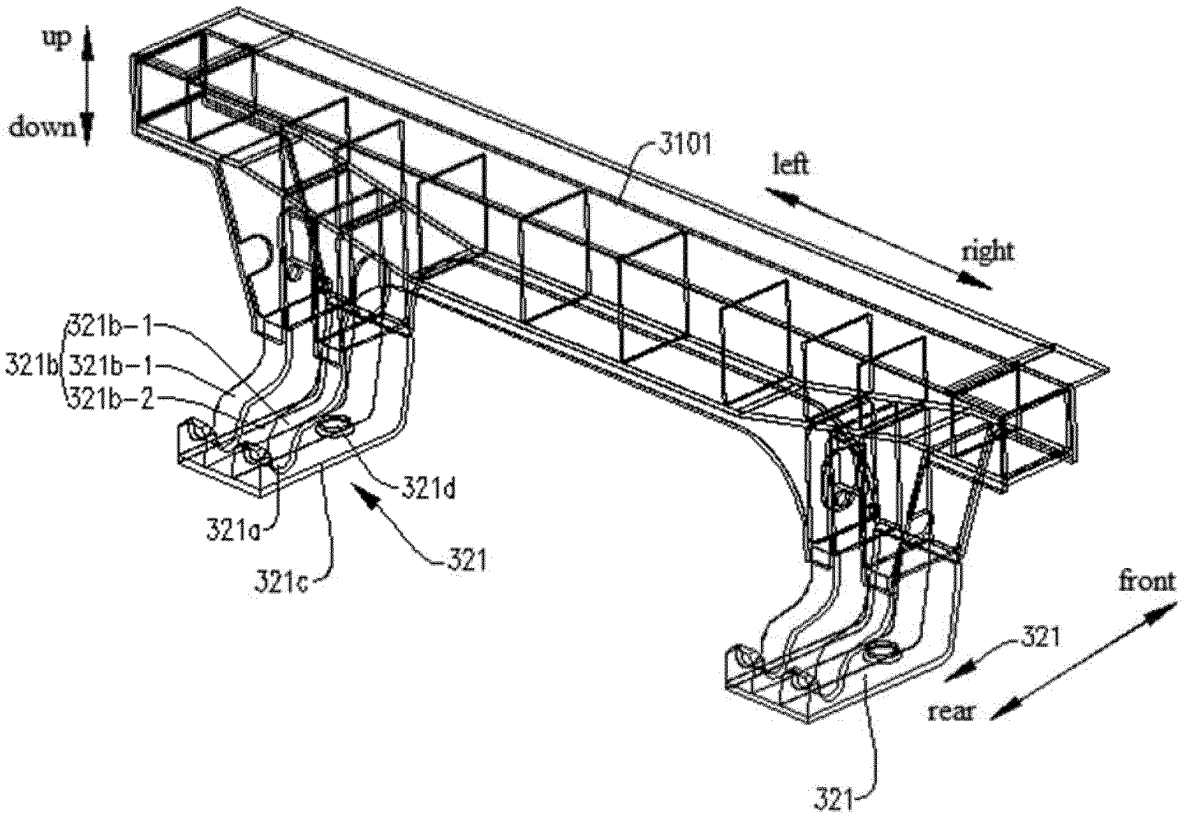

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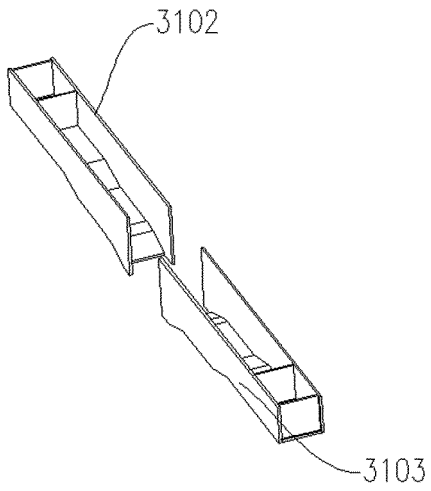

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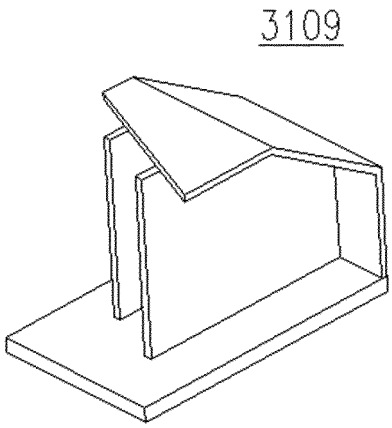

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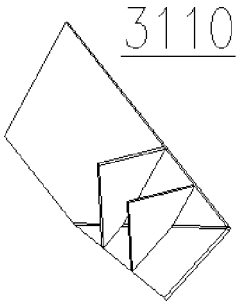

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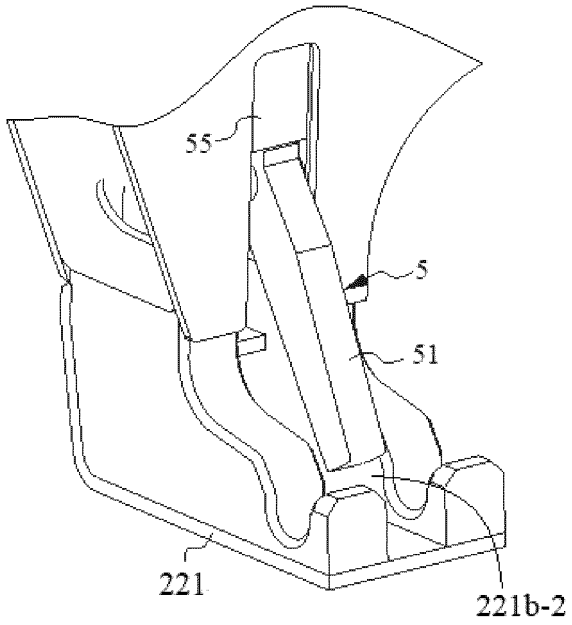

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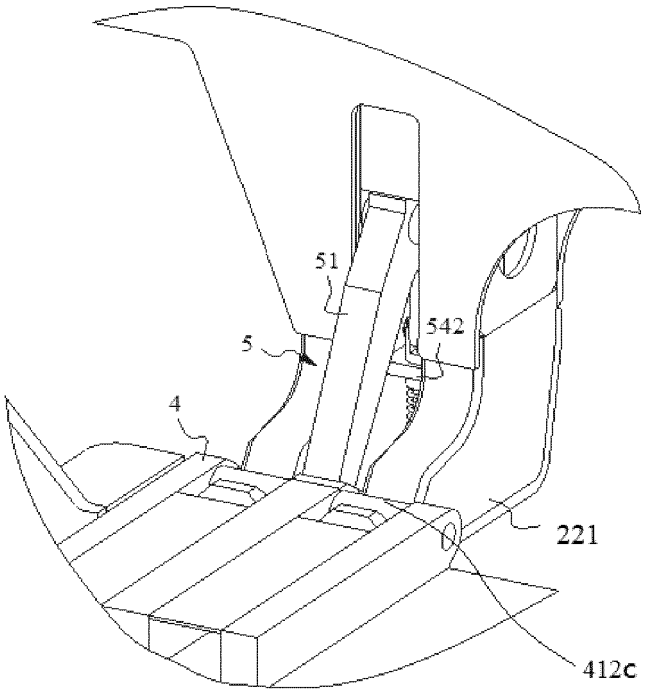

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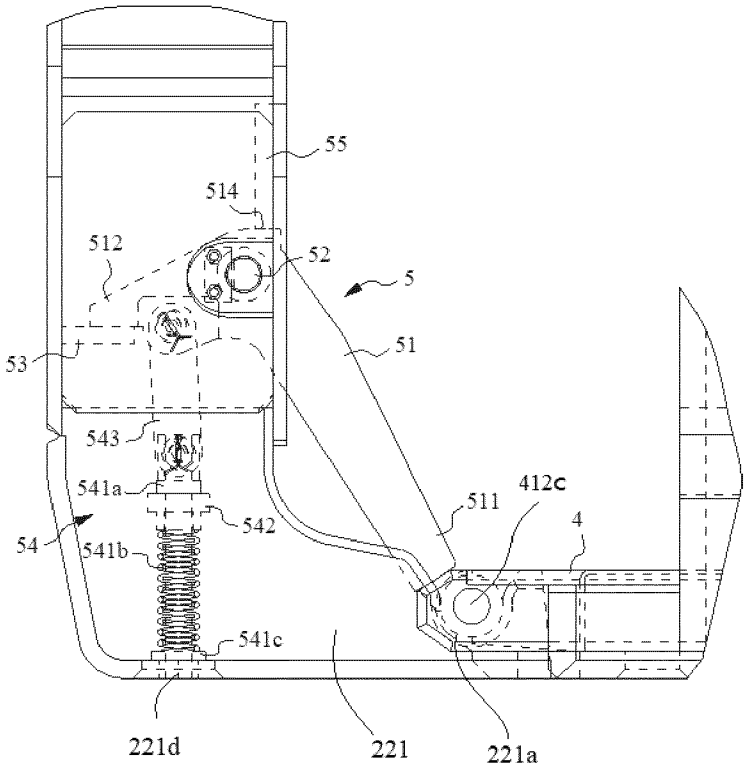

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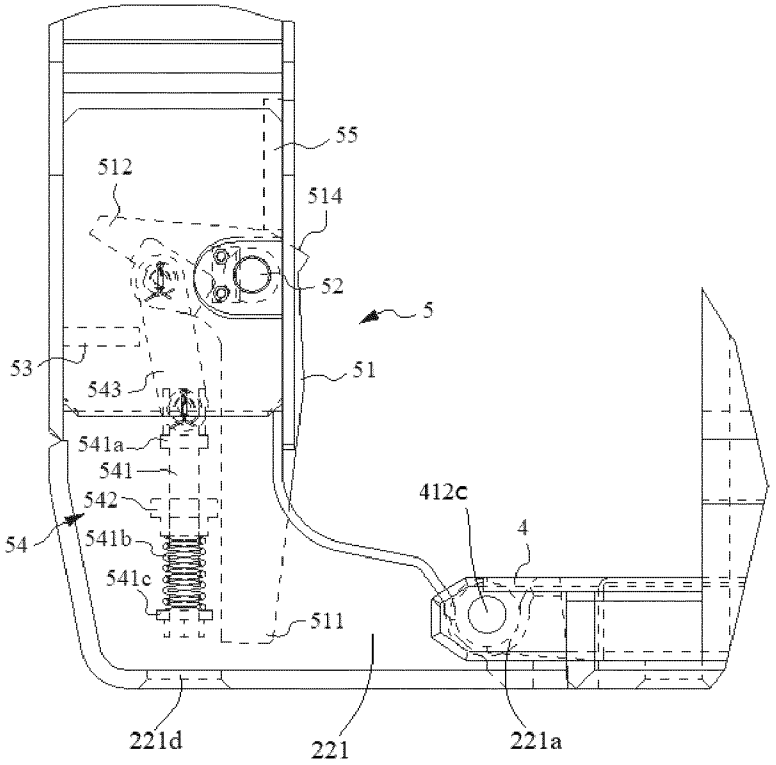

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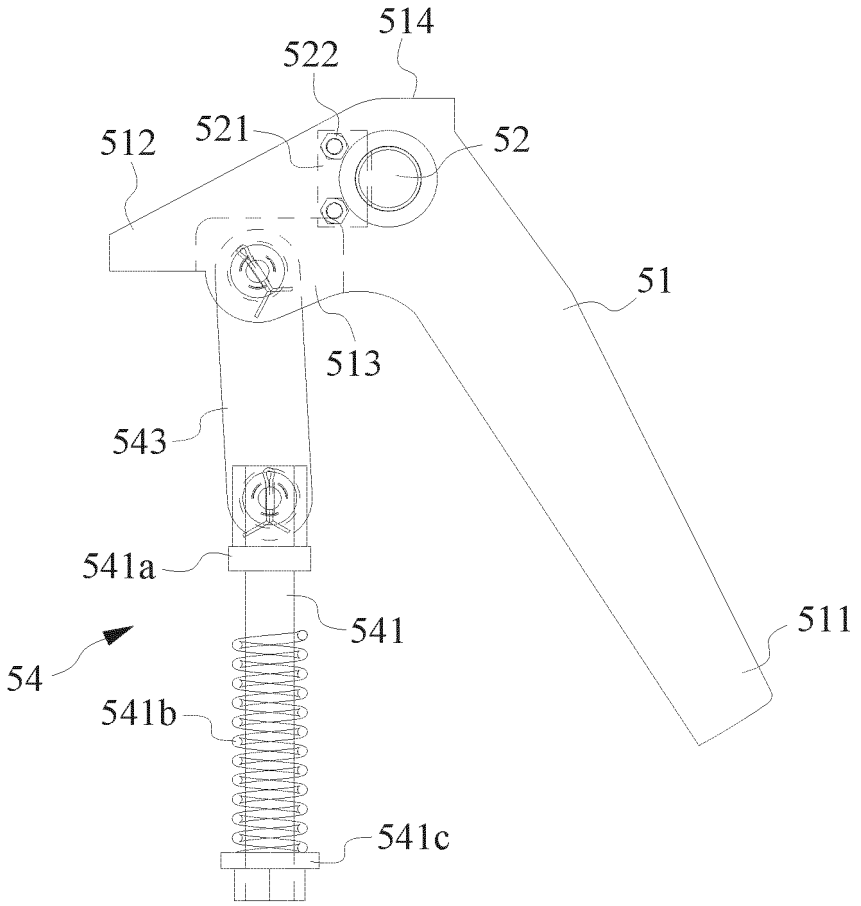

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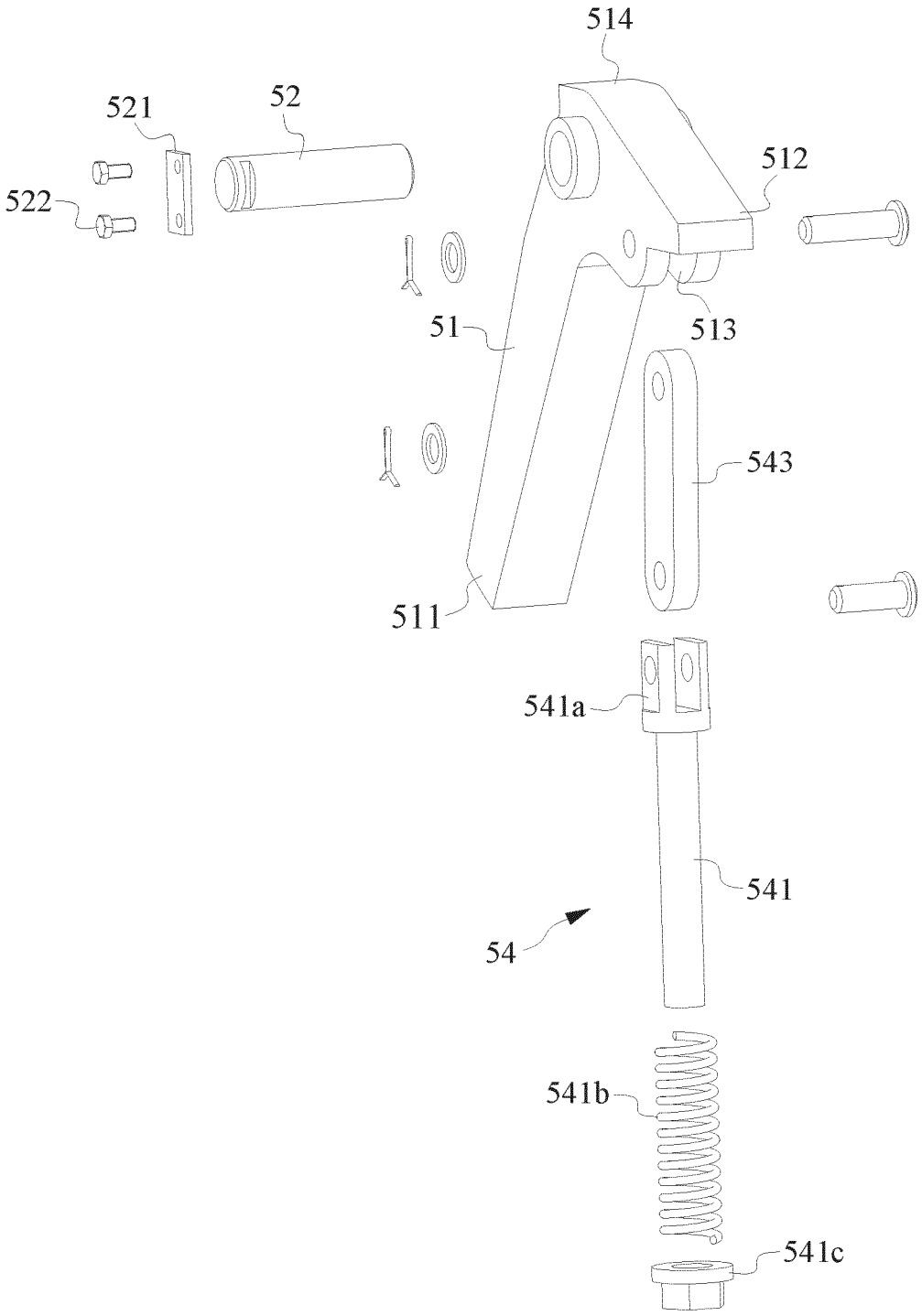

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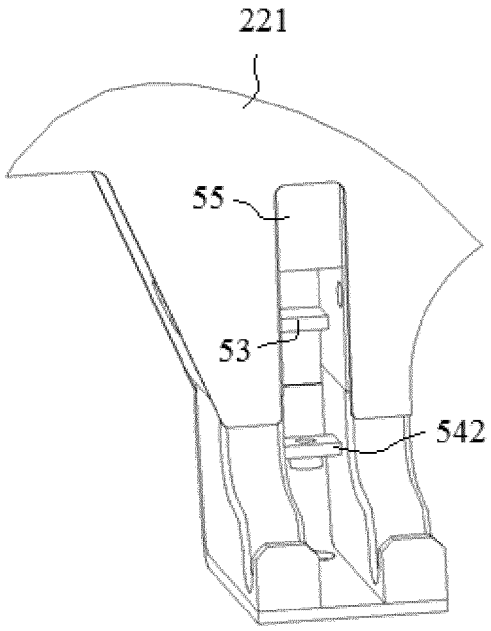

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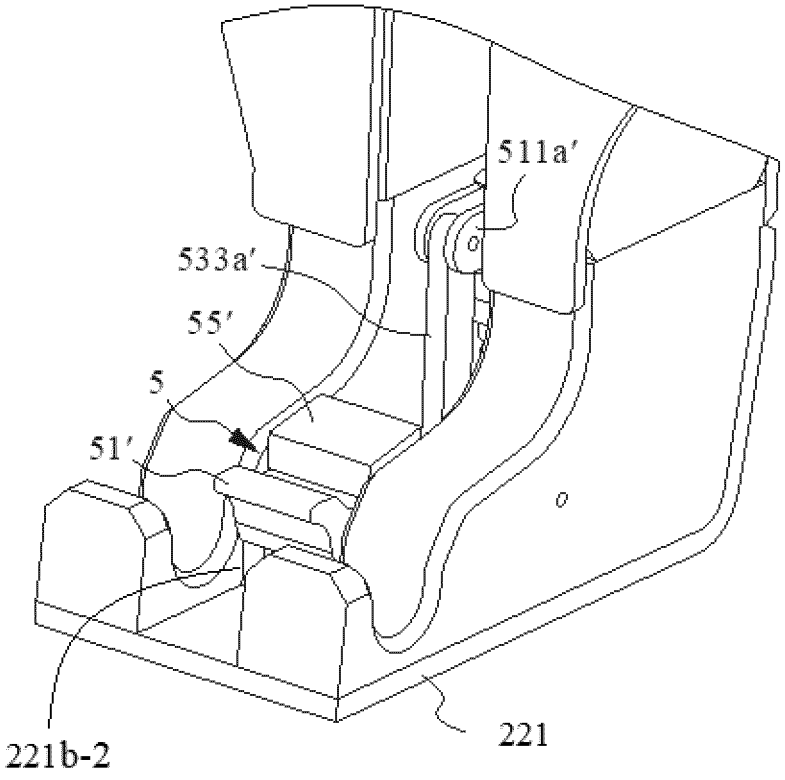

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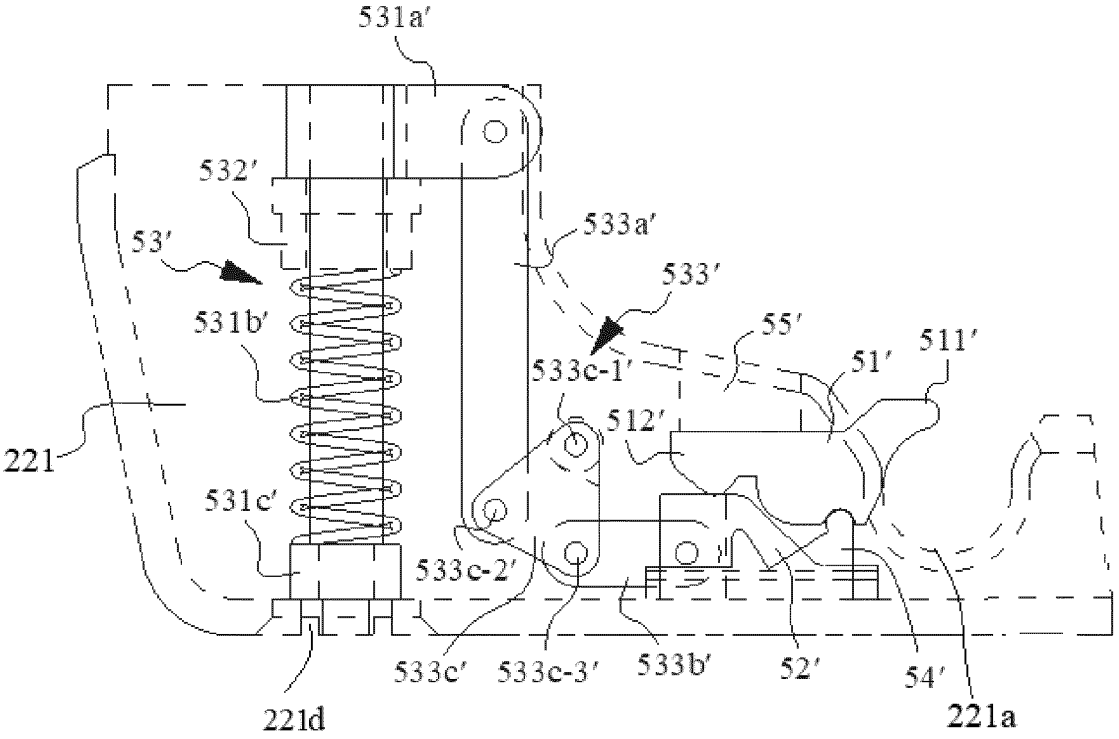

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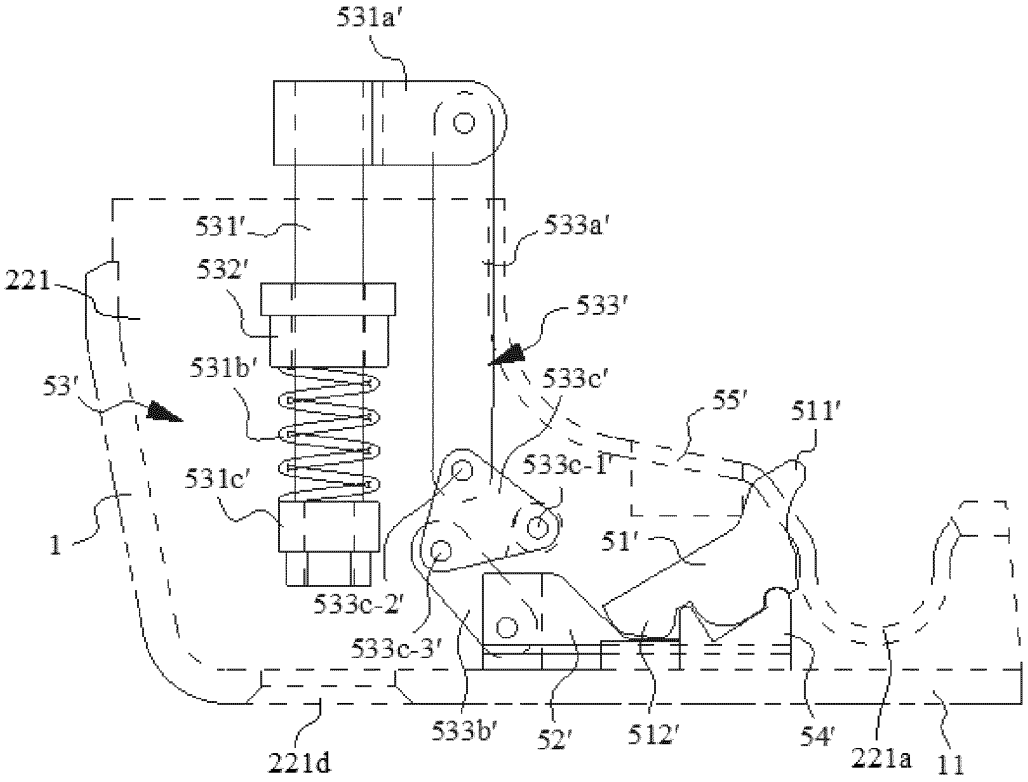

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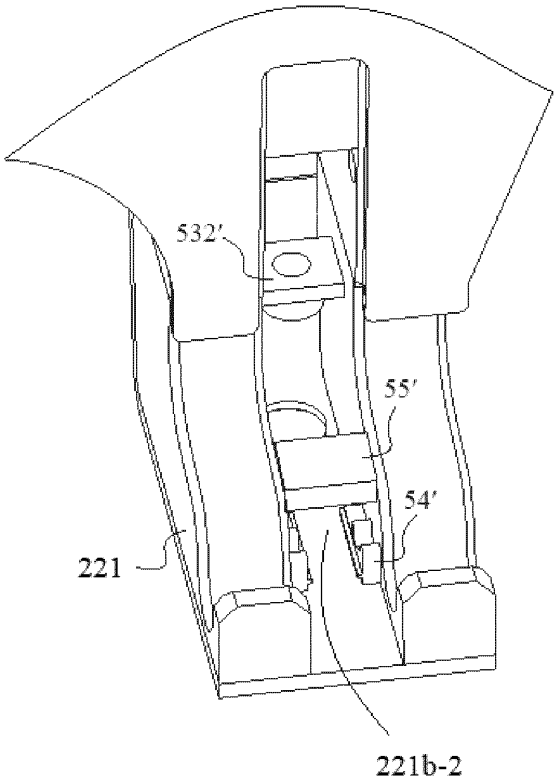

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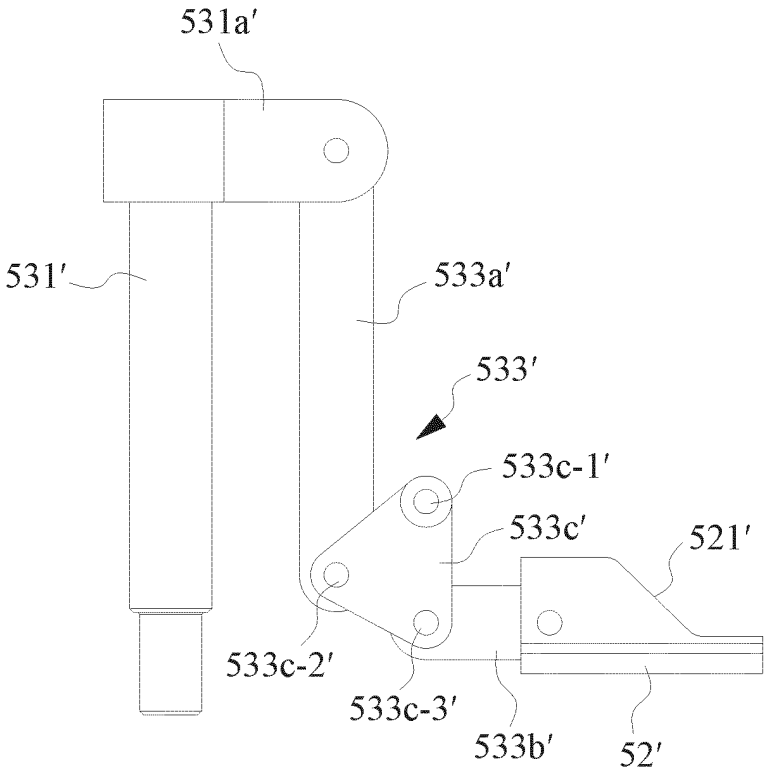

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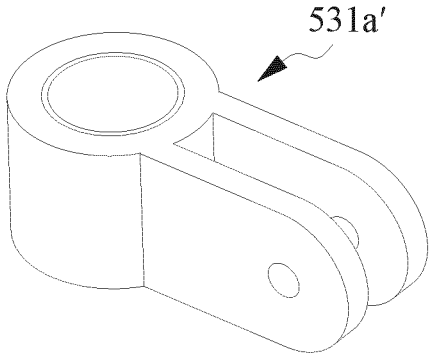

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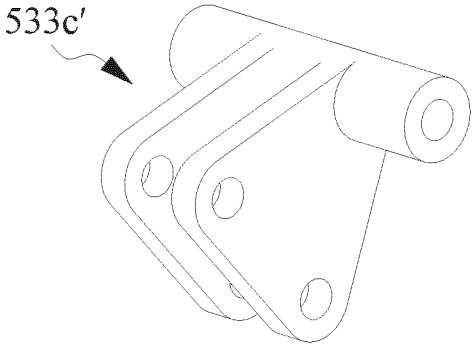

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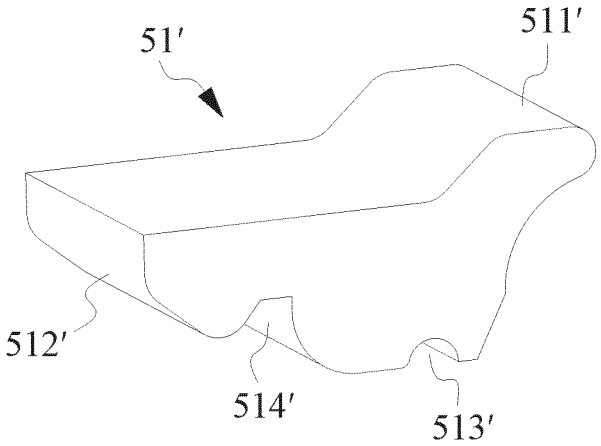

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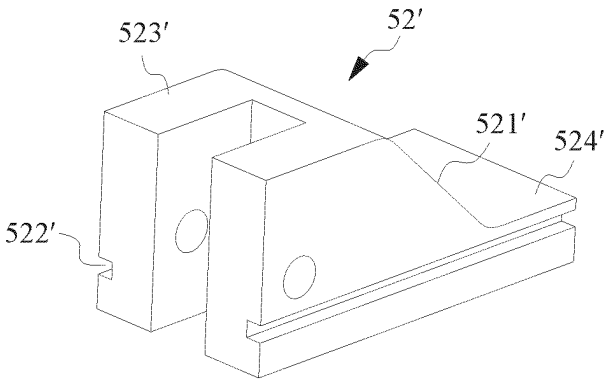

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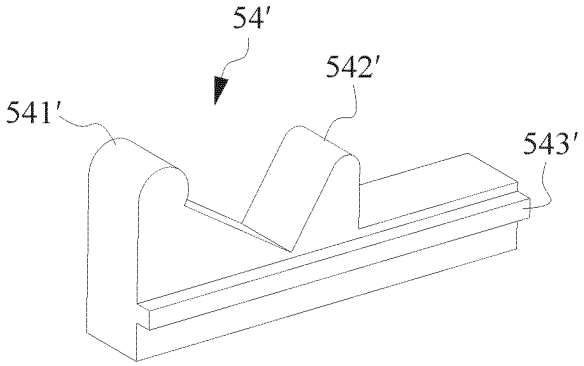

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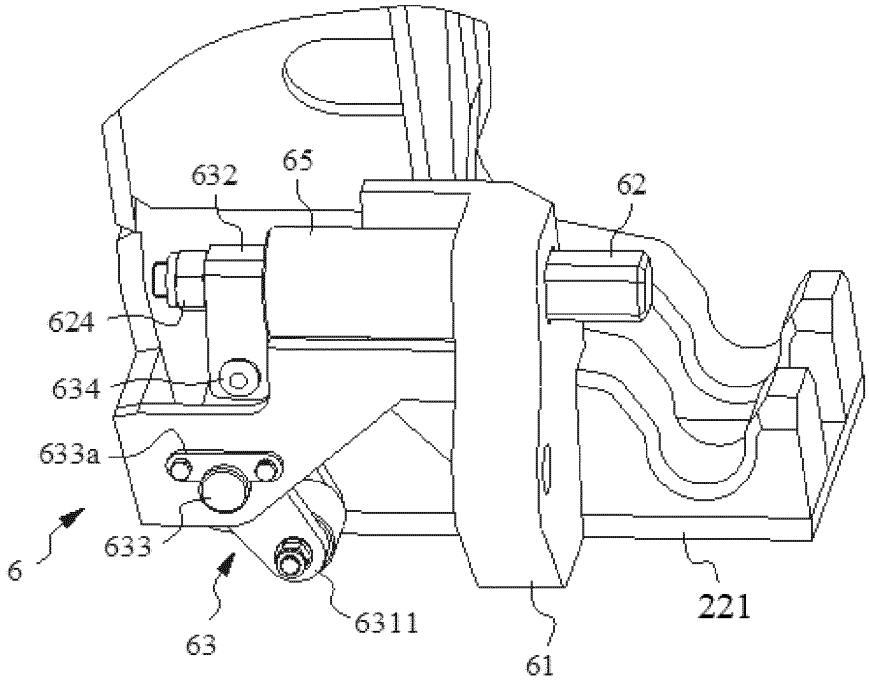

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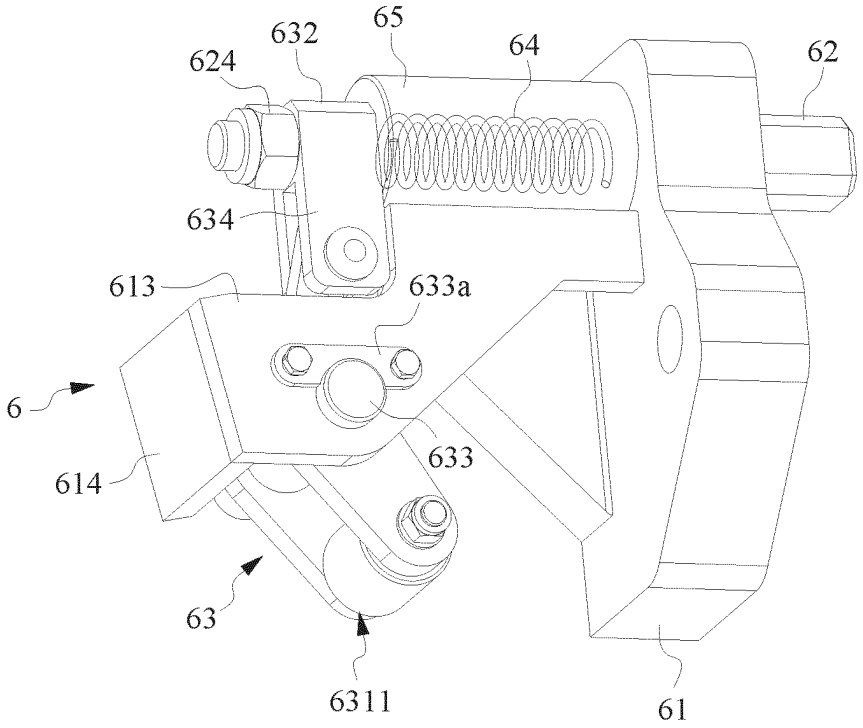

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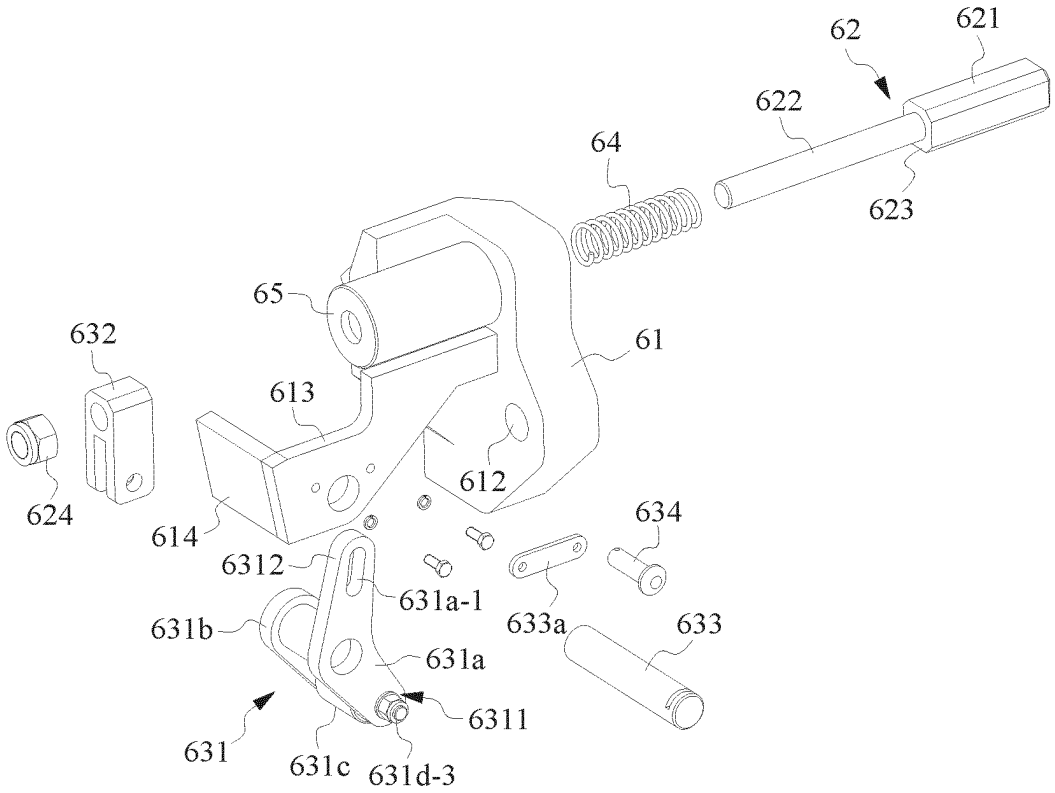

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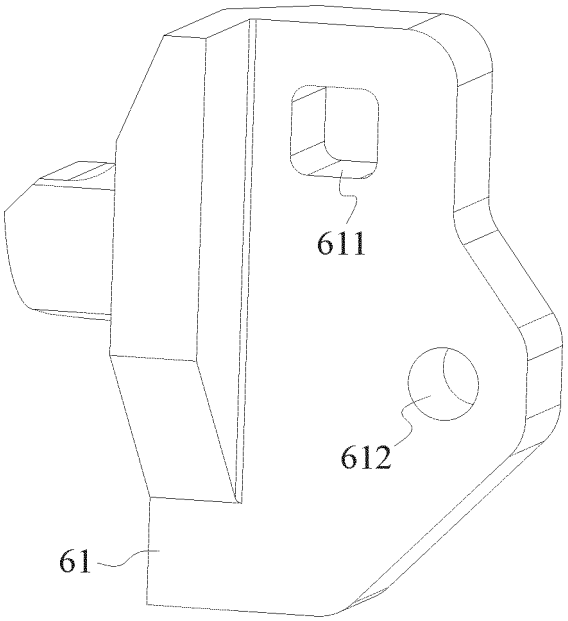

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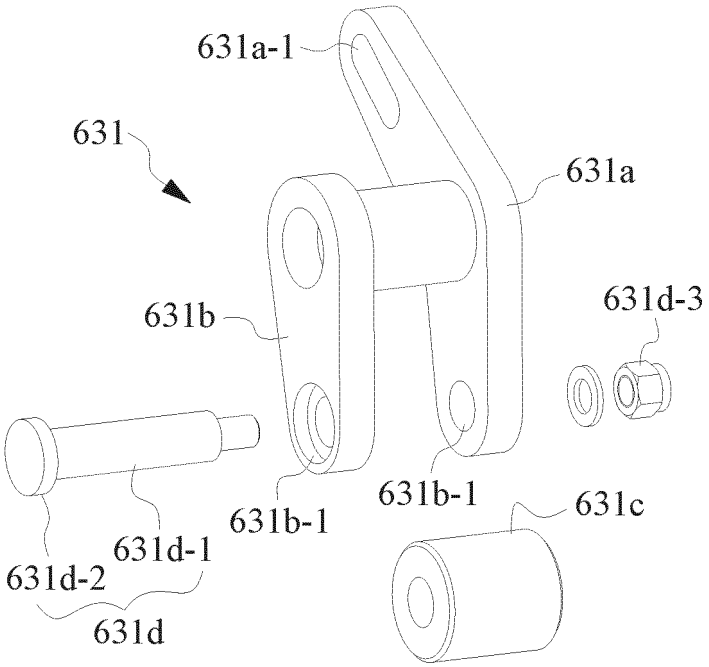

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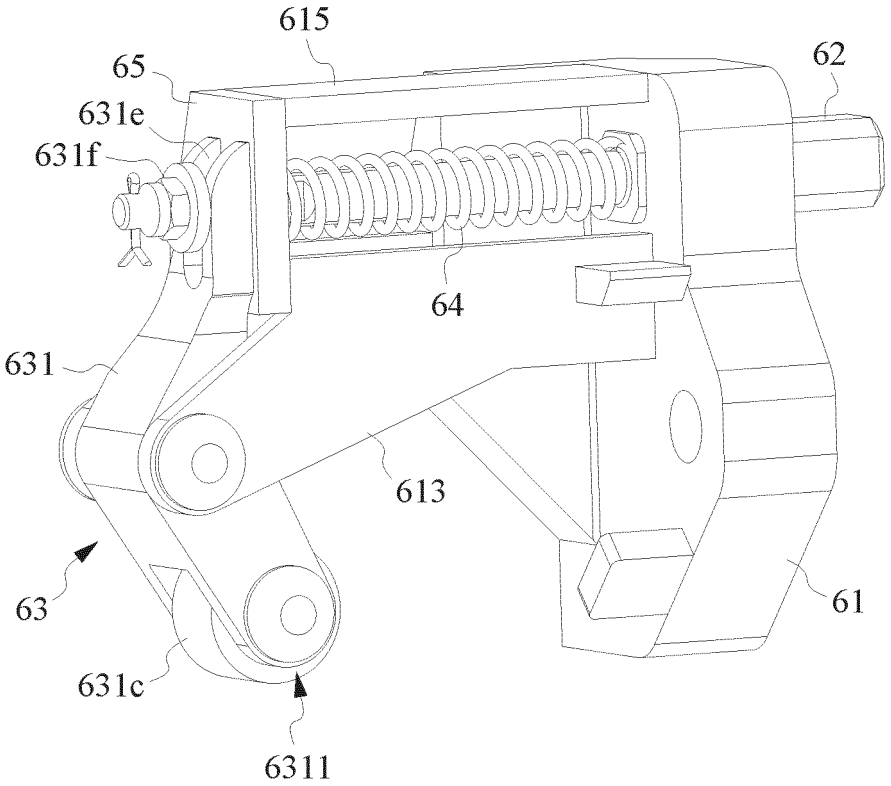

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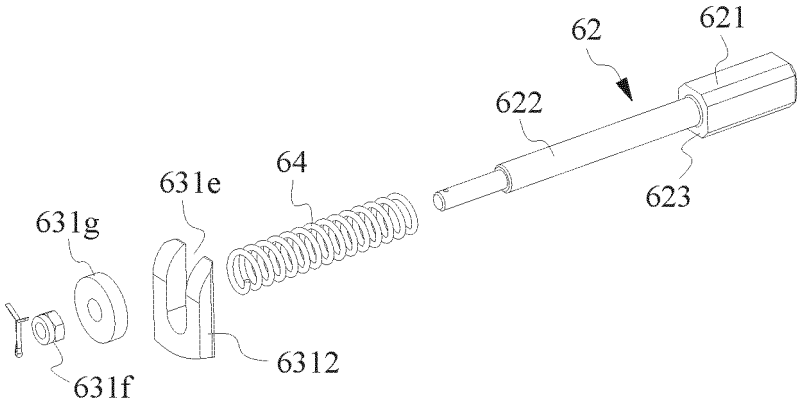

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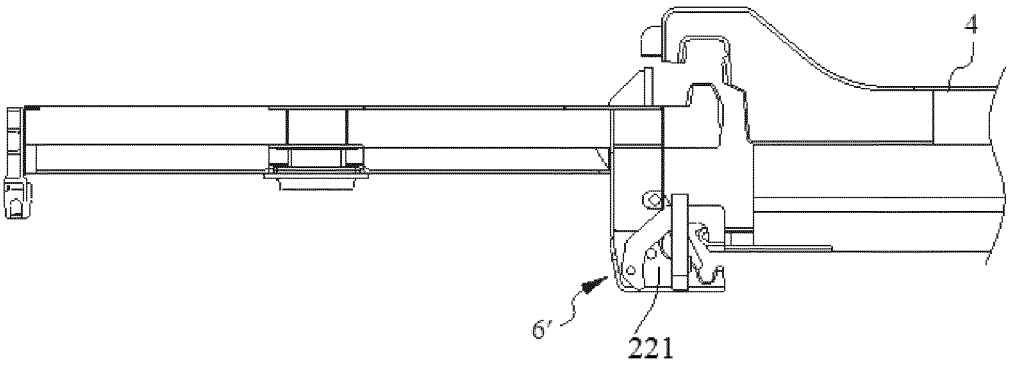

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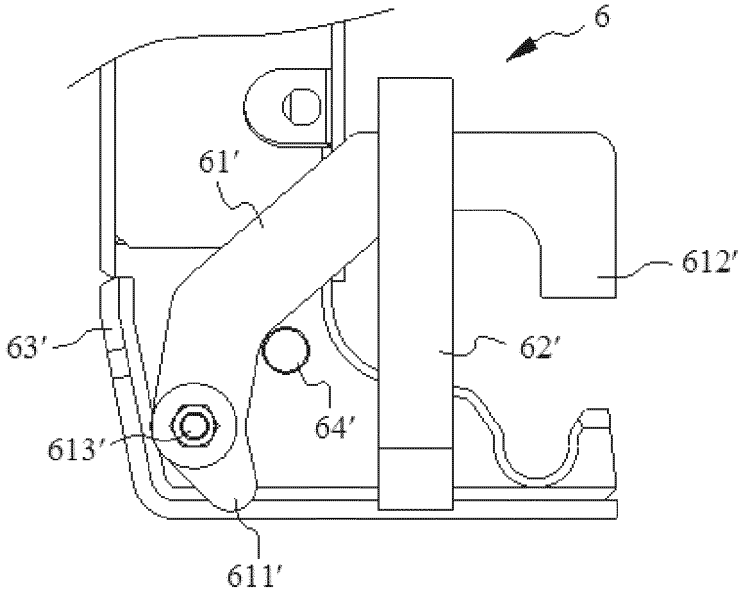

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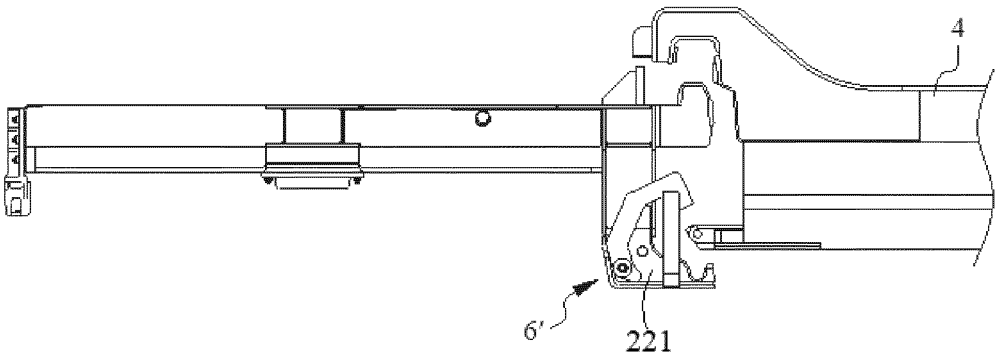

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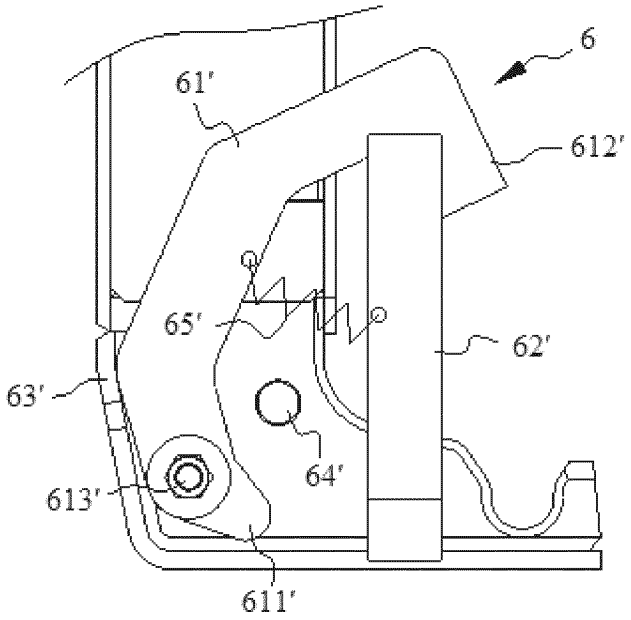

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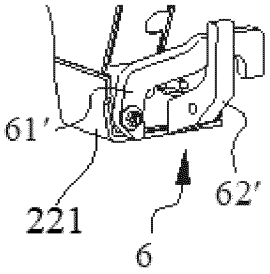

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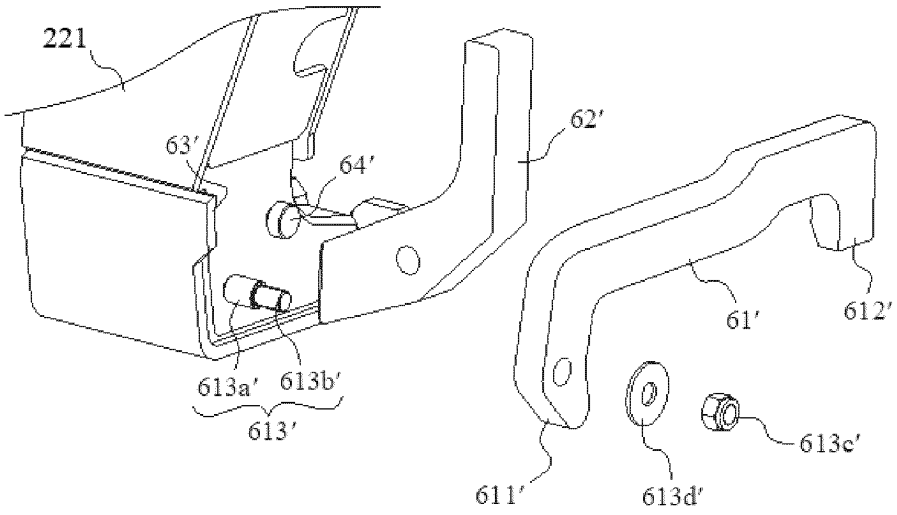

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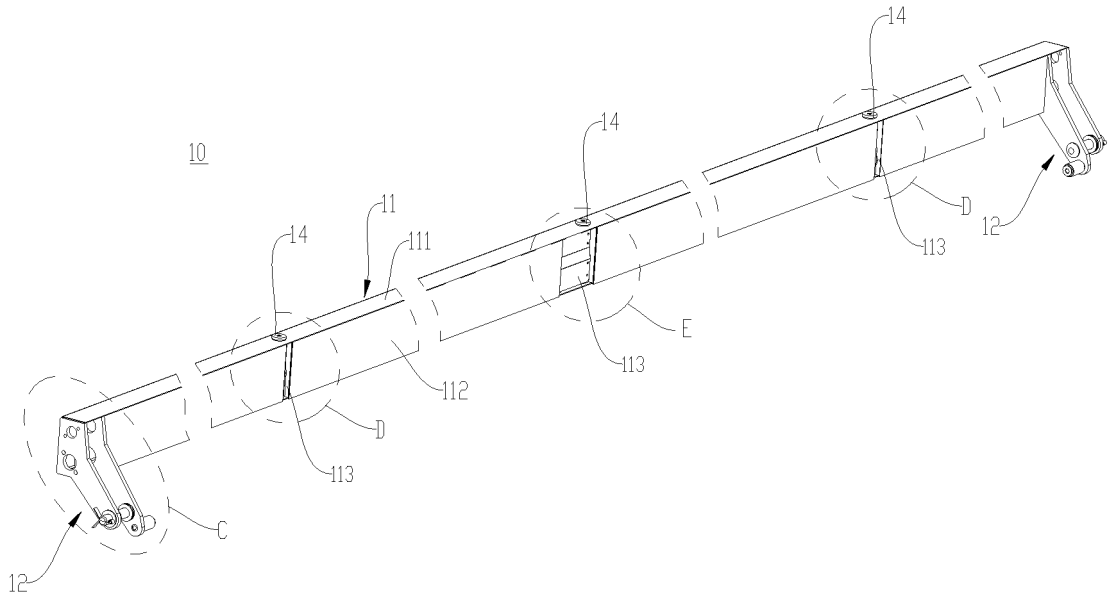

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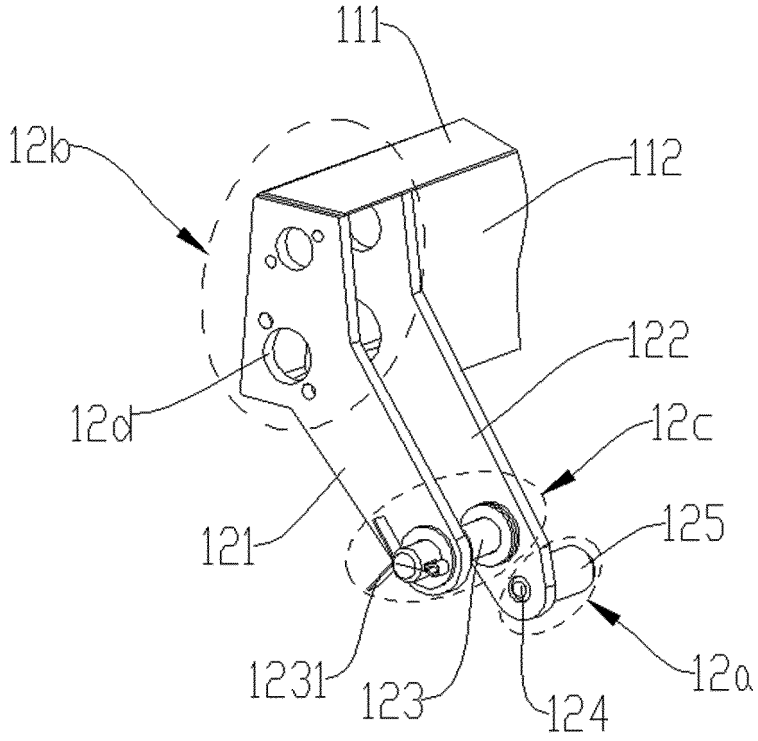

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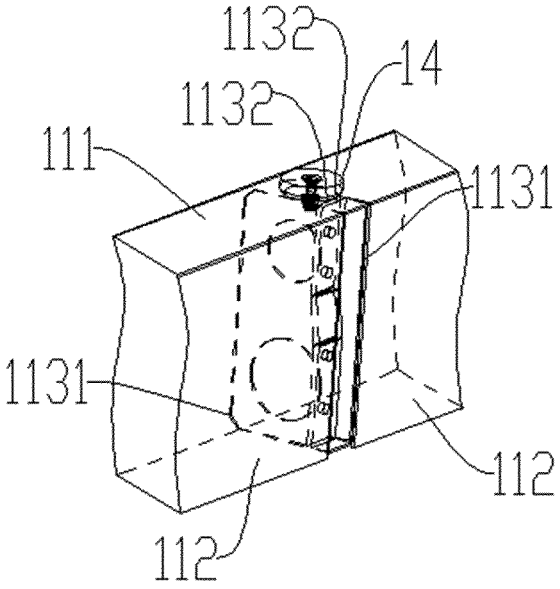

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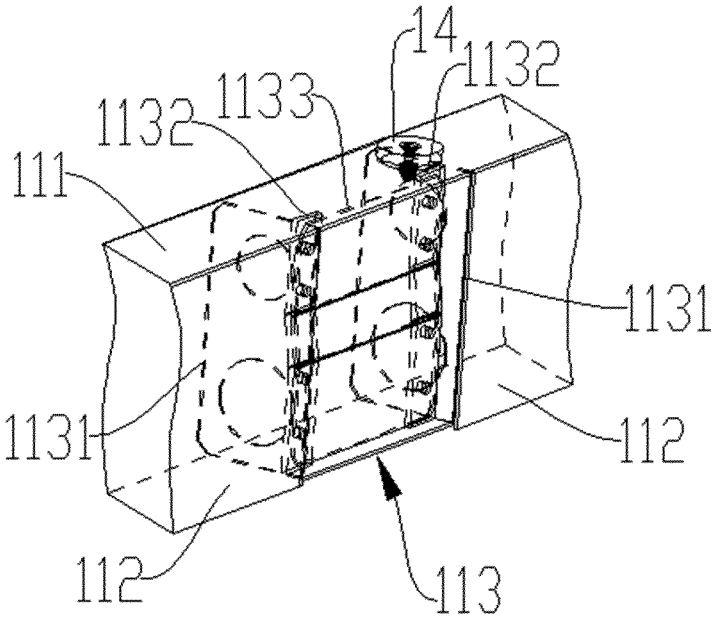

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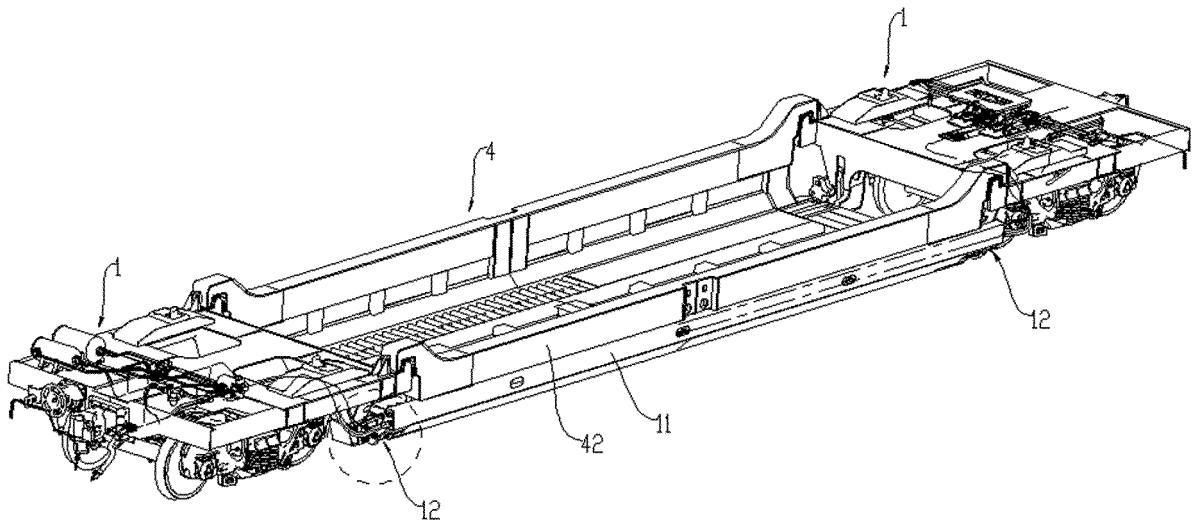

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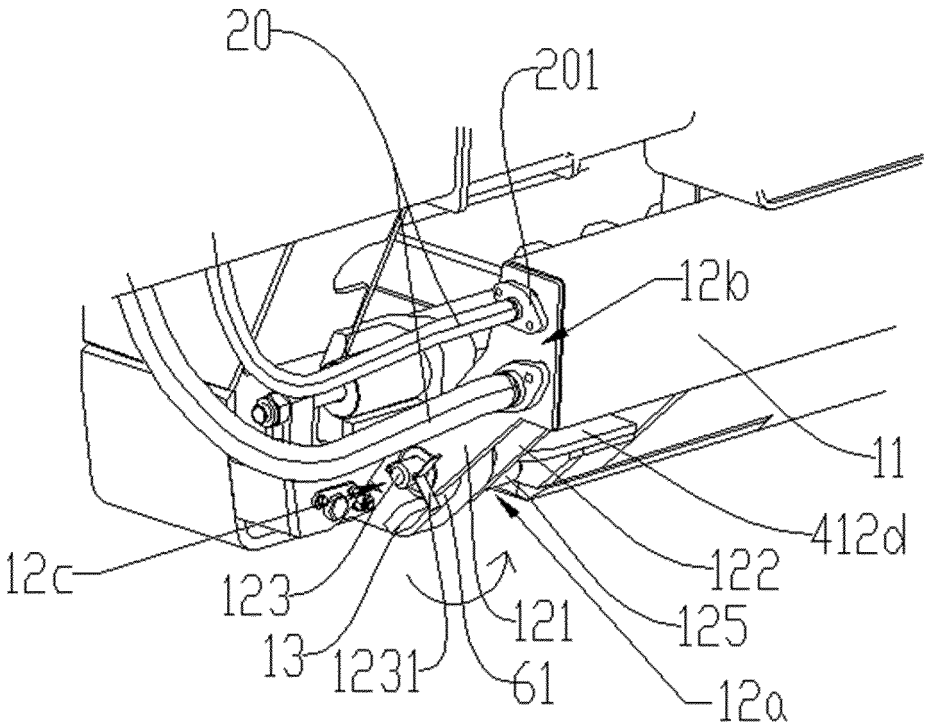

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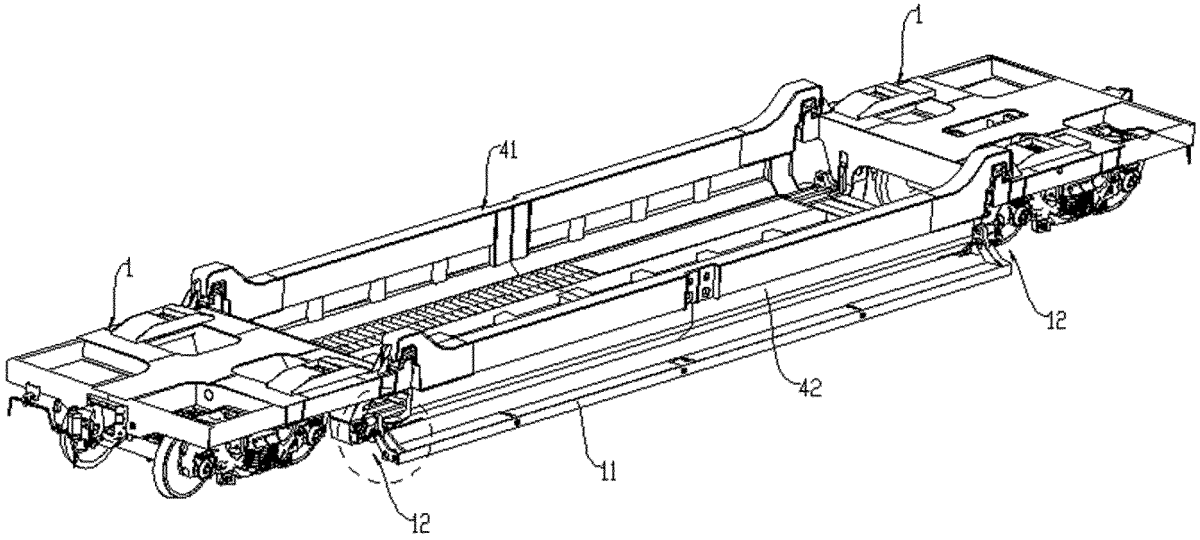

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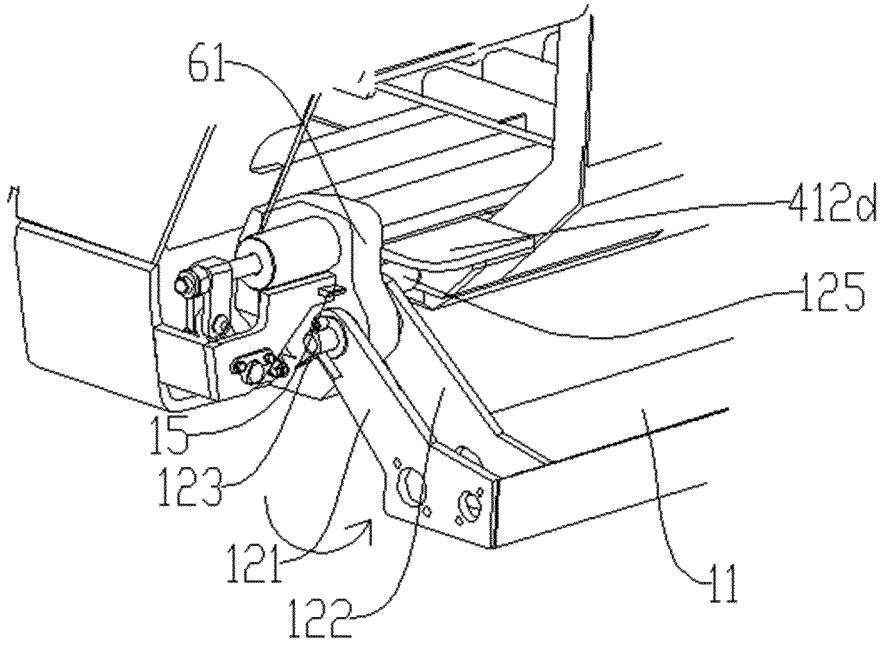

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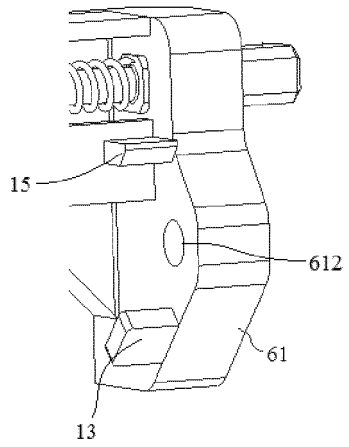

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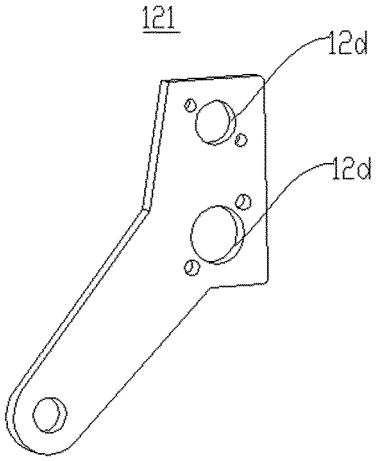

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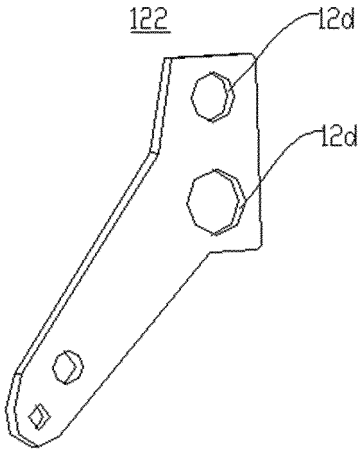

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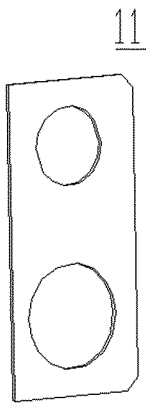

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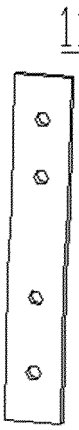

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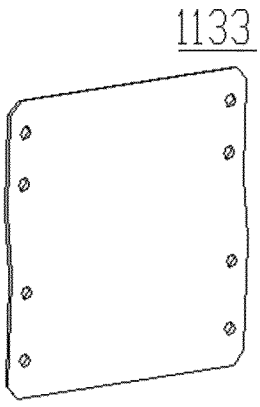

Figure 81

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2020/105719

A. CLASSIFICATION OF SUBJECT MATTER

B61D 3/18(2006.01)i; B61D 47/00(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

B61D

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

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

CNPAT, CNKI, WPI, EPODOC: 驮背, 钩, 勾, 圆轴, 连接, 托部, 锁, 止挡, 管, 防护; piggyback, back , connecting, hook, claw, clasp, shaft, round, lock, stop, pipe, defend, protect

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
PX	CN 111301445 A (CRRC QIQIHAR ROLLING STOCK CO., LTD.) 19 June 2020 (2020-06-19) claims 1-33, description, paragraphs [0005]-[0372], and figures 1-81	1-33
PX	CN 111301449 A (CRRC QIQIHAR CO., LTD.) 19 June 2020 (2020-06-19) claims 1-52, description, paragraphs [0005]-[0455], and figures 1-111	1-33
PX	CN 111137315 A (CRRC QIQIHAR CO., LTD.) 12 May 2020 (2020-05-12) claims 1-50, description, paragraphs [0005]-[0423], and figures 1-100	1-33
PX	CN 111376938 A (CRRC QIQIHAR CO., LTD.) 07 July 2020 (2020-07-07) claims 1-20, description, paragraphs [0005]-[0222], and figures 1-46	1, 4, 7-26, 32, 33
E	CN 211869369 U (CRRC QIQIHAR CO., LTD.) 06 November 2020 (2020-11-06) claims 1-52, description, paragraphs [0005]-[0452], and figures 1-111	1-33
E	CN 211809615 U (CRRC QIQIHAR CO., LTD.) 30 October 2020 (2020-10-30) claims 1-20, description, paragraphs [0005]-[0222], and figures 1-46	1, 4, 7-26, 32, 33
Y	CN 204341033 U (QIQIHAR RAILWAY ROLLING STOCK CO., LTD. et al.) 20 May 2015 (2015-05-20) description, paragraphs [0076]-[0176], and figures 1-34	1-26, 32, 33

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

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
07 November 2020	**01 December 2020**
Name and mailing address of the ISA/CN **China National Intellectual Property Administration (ISA/CN)** **No. 6, Xitucheng Road, Jimenqiao, Haidian District, Beijing 100088** **China** Facsimile No. **(86-10)62019451**	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2020/105719

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	CN 104527668 A (QIQIHAR RAILWAY ROLLING STOCK CO., LTD. et al.) 22 April 2015 (2015-04-22) description, paragraphs [0076]-[0176], and figures 1-34	1-26, 32, 33
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