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# (54) TRANSITION COUPLER AND COUPLING METHOD THEREFOR

(57) The present application provides a transition coupler and a coupling method for the transition coupler. The transition coupler comprises a coupler head and a coupler rear, wherein a coupling surface formed on a side of the coupler head coupled with a train coupler, a coupler head housing is provided between the coupling surface and the coupler rear; a coupler hook structure is formed on the coupling surface, and is configured to be coupled with the coupler tongue of the train coupler; a female cone structure is formed on the coupling surface, and is configured to accommodate a male cone of the train coupler, the female cone structure comprises a cavity formed from the coupling surface toward an interior of the coupler head housing .

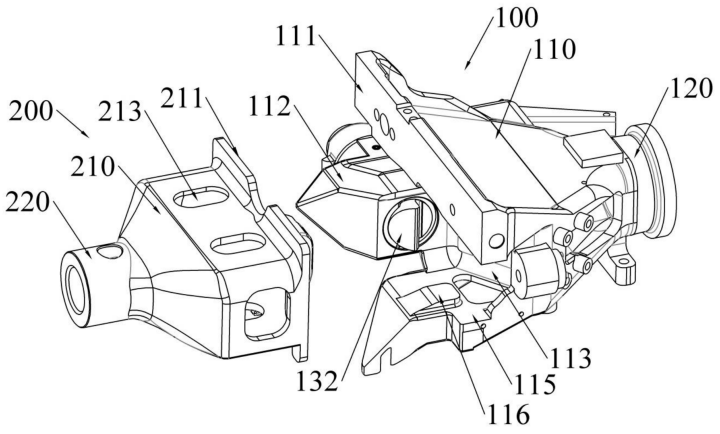


Fig. 3

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## Description

**[0001]** This application claims priority to the Chinese Patent Application 202411260408.2 filed to the CNIPA on September 10, 2024, the disclosure of which is hereby incorporated by reference in its entirety.

## Technical Field

**[0002]** The present application relates to the technical field of couplers for railway vehicles, and in particular to a transition coupler and a coupling method therefor.

## Background Art

**[0003]** A transition coupler is used to couple with a standard coupler during vehicle rescue. Different models and types of trains adopt different models of standard couplers. Since the structures of the standard couplers vary, universal transition couplers are known in the prior art, capable of being coupled with multiple models of standard couplers. However, due to the fixed structure of the universal transition couplers, it is difficult to adapt to the subtle differences among various models of standard couplers. Therefore, a preferred approach is to provide a dedicated transition coupler for each model of the standard couplers for coupling.

**[0004]** Currently, transition couplers for railway vehicles used domestically and abroad include Type-10 transition couplers, Shibata-type transition couplers, and locomotive transition couplers. However, for the current BSI-type standard couplers, there has not yet been a practical and reliable transition coupler.

## Summary

**[0005]** The purpose of the present application is to solve the above technical problems and to propose a transition coupler and a coupling method therefor.

**[0006]** In a first aspect, the present application provides a transition coupler for coupling with a train coupler, the train coupler comprising a coupler head, a male cone and a female cone formed on the coupler head, a coupler hook is retractably provided on the male cone toward the female cone; the transition coupler comprising:

a coupler head of the transition coupler and a coupler rear of the transition coupler: wherein a coupling surface of the transition coupler is formed on a side of the coupler head of the transition coupler coupled with the train coupler, and a coupler head housing is provided between the coupling surface of the transition coupler and the coupler rear of the transition coupler;

a coupler hook structure is formed on the coupling surface of the transition coupler, and is configured to be coupled with the coupler hook of the train coupler; the coupler hook structure comprises a male cone of the transition coupler formed on the coupling surface of the transition coupler, and a coupler hook block is provided on a side surface of the male cone of the transition coupler adjacent to a female cone structure;

the female cone structure is formed on the coupling surface of the transition coupler, and is configured to accommodate the male cone of the train coupler; the female cone structure comprises a female cone cavity formed from the coupling surface of the transition coupler toward an interior of the coupler head housing.

**[0007]** In some embodiments of the first aspect, an inclined surface is formed on the coupler hook block, a wider end of the inclined surface is adjacent to the coupling surface of the transition coupler, and an edge of the inclined surface at a side adjacent to the coupling surface of the transition coupler is retracted toward a side away from the female cone structure to form a coupler hook of the transition coupler.

**[0008]** In some embodiments of the first aspect, an inclined surface is provided on a front side of the coupler hook block, and the inclined surface of the coupler hook block is inclined from front toward rear of the transition coupler in a direction away from the male cone of the transition coupler, and a surface behind the inclined surface of the coupler hook block is connected to a sidewall of the female cone cavity to form a coupler hook of the transition coupler.

**[0009]** In some embodiments of the first aspect, a bottom of the female cone of the train coupler extends forward of the coupler head of the train coupler to form a plate-shaped structure, and a first positioning protrusion is provided on an upper surface of the plate-shaped structure; a first auxiliary positioning block is provided at a bottom of the male cone of the transition coupler; when the transition coupler is coupled with the train coupler, the first auxiliary positioning block of the transition coupler cooperates with the first positioning protrusion of the train coupler for positioning.

**[0010]** In some embodiments of the first aspect, a second positioning protrusion is provided at a bottom of the male cone of the train coupler; a second auxiliary positioning block is provided on an inner surface of a bottom of the female cone cavity of the transition coupler, and the second auxiliary positioning block is protruded into the female cone cavity; when the transition coupler is coupled with the train coupler, the male cone of the train coupler extends into the female cone cavity of the transition coupler, and the second auxiliary positioning block cooperates with the second positioning protrusion for positioning.

**[0011]** In some embodiments of the first aspect, a bottom of the female cone of the train coupler extends forward of the coupler head of the train coupler to form a plate-shaped structure, and a third positioning protrusion is formed on a side surface of the plate-shaped structure

facing a space below the male cone of the train coupler; a bottom of the female cone cavity of the transition coupler extends further downward relative to a bottom of the male cone of the transition coupler, and a transition structure connecting the bottom of the female cone cavity and the bottom of the male cone of the transition coupler is formed between the female cone structure and the coupler hook structure, a side surface of the transition structure facing a space below the male cone of the transition coupler is a transition side surface; when the transition coupler is coupled with the train coupler, the transition side surface of the transition coupler cooperates with the third positioning protrusion of the train coupler for positioning.

**[0012]** In some embodiments of the first aspect, an extension block facing a direction of the female cone structure is provided on the male cone of the transition coupler; when the transition coupler is coupled with the train coupler, a side surface of the extension block facing the direction of the female cone structure cooperates with a side surface of the male cone of the train coupler for positioning.

**[0013]** In some embodiments of the first aspect, a shape of the female cone cavity of the transition coupler matches an external profile of the male cone of the train coupler.

**[0014]** In some embodiments of the first aspect, a recessed notch extending toward the coupler rear of the transition coupler is formed on a sidewall, away from the coupler hook block, of the female cone cavity of the female cone structure of the transition coupler; when the transition coupler is coupled with the train coupler, an uncoupling handle of the train coupler is accommodated in the recessed notch.

**[0015]** A second aspect of the present application provides a coupling method for a transition coupler, which is applied to the transition coupler described in any one of the first aspects, comprising following steps:

the coupler hook block of the transition coupler contacting the coupler hook of the train coupler; the transition coupler and the train coupler moving toward each other, and the coupler hook block of the transition coupler and the coupler hook of the train coupler being pressed against each other, causing the coupler hook of the train coupler to retract; the coupler hook block of the transition coupler sliding behind the coupler hook of the train coupler, and pressure applied to the coupler hook of the train coupler being disappeared, so that the coupler hook of the train coupler extends out and limits the coupler hook block of the transition coupler, thereby completing coupling.

**[0016]** **In** some embodiments of the second aspect, the coupler hook of the train coupler comprises a coupler hook rod and a coupler hook head provided at an end of the coupler hook rod, an inclined surface is formed on a side of the coupler hook head facing the transition coupler, and the inclined surface of the coupler hook head is inclined in a direction away from the transition coupler; an inclined surface of the coupler hook block is provided on a front side of the coupler hook block, the inclined surface of the coupler hook block is inclined from front toward rear of the transition coupler in a direction away from the male cone of the transition coupler, the inclined surface of the coupler hook head and the inclined surface of the coupler hook block having complementary inclinations;

the coupling method further comprises following steps: during the coupling between the transition coupler and the train coupler, the inclined surface of the coupler hook block of the transition coupler is in contact with the inclined surface of the coupler hook head of the train coupler, in a process of the coupler hook block of the transition coupler and the coupler hook head of the train coupler pressing against each other, the coupler hook block of the transition coupler is guided to a rear side of the coupler hook head of the train coupler through cooperation of the inclined surface of the coupler hook block and the inclined surface of the coupler hook head, thereby completing the coupling.

**[0017]** **In** some embodiments of the second aspect, a bottom of the female cone of the train coupler extends forward of the coupler head of the train coupler to form a plate-shaped structure, a first positioning protrusion is provided on an upper surface of the plate-shaped structure, and a first auxiliary positioning block is provided at a bottom of the male cone of the transition coupler;

the coupling method further comprises following steps: during the coupling between the transition coupler and the train coupler, the male cone of the transition coupler extends into an interior of the female cone of the train coupler, and the first auxiliary positioning block and the first positioning protrusion cooperate to position the train coupler and the transition coupler in a vertical direction.

**[0018]** In some embodiments of the second aspect, a second positioning protrusion is provided at a bottom of the male cone of the train coupler; a second auxiliary positioning block is provided on an inner surface of a bottom of the female cone cavity of the transition coupler, and the second auxiliary positioning block is protruded into the female cone cavity;

the coupling method further comprises following steps: during the coupling between the transition coupler and the train coupler, the male cone of the train coupler extends into the female cone cavity of the transition coupler, and the second positioning protrusion and the second auxiliary positioning block cooperate to position the train coupler and the transition coupler in a vertical direction.

**[0019]** In some embodiments of the second aspect, a bottom of the female cone of the train coupler extends forward of the coupler head of the train coupler to form a plate-shaped structure, a third positioning protrusion is formed on a side surface of the plate-shaped structure facing a space below the male cone of the train coupler; a bottom of the female cone cavity of the transition coupler extends further downward relative to a bottom of the male cone of transition coupler, a transition structure connect-

ing the bottom of the female cone cavity and the bottom of the male cone of the transition coupler is formed between the female cone structure and the coupler hook structure, and a side surface of the transition structure facing a space below the male cone is a transition side surface;
the coupling method further comprises following steps: during the coupling between the transition coupler and the train coupler, the transition side surface on the transition coupler cooperates with the third positioning protrusion on the train coupler to perform positioning in a horizontal direction.

**[0020]** In some embodiments of the second aspect, an extension block facing a direction of the female cone structure is provided on the male cone of the transition coupler;
the coupling method further comprises following steps: during the coupling between the transition coupler and the train coupler, a side surface of the extension block facing the direction of the female cone structure cooperates with a side surface of the male cone of the train coupler to perform positioning in a horizontal direction.

**[0021]** Compared with the prior art, the transition coupler provided by the present application has the following beneficial effects.

1. The transition coupler can be applied to tight-lock couplers, in particular to BSI couplers, realizing the availability of transition couplers for BSI-type couplers both domestically and internationally, which were previously unavailable.
2. Adapting to the special knuckle structure of BSI couplers and the like, a fixed coupler hook structure and a coupler hook guiding structure are designed. Through the unique guiding function of the transition coupler, automatic coupling between a rescue train and a rescued train coupler can be achieved, thereby meeting the requirements of rescue and towed trains in rail transit, reducing the difficulty and cost of rescue, and ensuring that the rescue time meets the requirements of passenger railway transportation.
3. A novel one-sided pressing type automatic coupling method applicable to the transition coupler is provided. With the cooperation of the fixed knuckle of the transition coupler and multiple positioning structures, automatic coupling of the transition coupler is realized.

## BRIEF DESCRIPTION OF THE DRAWINGS

**[0022]** In order to more clearly explain the technical solutions of the present application, the following will make a brief introduction to the figures that are used in the description of the embodiments. Obviously, the figures in the following description are only some of embodiments of the present application, and for those of ordinary skill in the art, other figures can also be derived from these figures without creative labor.

Fig. 1a is a first perspective view of a BSI coupler;
Fig. 1b is a second perspective view of the BSI coupler;
Fig. 2a is a first perspective view of a transition coupler according to an embodiment of the present application;
Fig. 2b is a second perspective view of the transition coupler according to the embodiment of the present application;
Fig. 2c is a third perspective view of the transition coupler according to the embodiment of the present application;
Fig. 2d is a bottom view of the transition coupler according to the embodiment of the present application;
Fig. 3 is a perspective view of the transition coupler and the BSI coupler during a coupling process according to an embodiment of the present application;
Fig. 4a is a cross-sectional view of the transition coupler and the BSI coupler in a first state during the coupling process according to the embodiment of the present application;
Fig. 4b is a cross-sectional view of the transition coupler and the BSI coupler in a second state during the coupling process according to the embodiment of the present application;
Fig. 5a is a cross-sectional view of the transition coupler and the BSI coupler in a first state during an uncoupling process according to an embodiment of the present application;
Fig. 5b is a cross-sectional view of the transition coupler and the BSI coupler in a second state during the uncoupling process according to the embodiment of the present application.

**[0023]** In the figures:

100-BSI coupler (i.e., train coupler); 110-coupler head of BSI coupler; 111-coupling surface of BSI coupler; 112-male cone of BSI coupler; 1121-fourth positioning protrusion; 113-female cone of BSI coupler; 114-cavity for accommodating coupler hook; 115-plate-shaped structure; 116-first positioning protrusion; 117-second positioning protrusion; 118-third positioning protrusion; 119-guiding inclined surface; 120-coupler rear of BSI coupler; 130-coupler hook of BSI coupler; 131-coupler hook rod; 132-coupler hook head; 133-inclined surface of coupler hook head; 140-spring; 150-uncoupling handle;
200-transition coupler; 210-coupler head of transition coupler; 211-coupling surface of transition coupler; 212-coupler head housing of transition coupler; 213-weight-reducing hole; 214-recessed notch; 220-coupler rear of transition coupler; 221-coupling link pin hole; 230-coupler hook structure; 231-male cone of transition coupler; 232-coupler hook block; 2321-inclined surface of coupler hook block; 233-extension block; 240-female cone structure; 241-

female cone cavity; 251-first auxiliary positioning block; 252-second auxiliary positioning block; 260-transition structure; 261-transition side surface.

## DETAILED DESCRIPTION OF EMBODIMENTS

**[0024]** In order to make the technical problems to be solved, technical solutions and beneficial effects of the present application more clearly, this application is further described in detail below in conjunction with the accompanying drawings and embodiments. It should be understood that the specific embodiments described herein are only used to explain the present application and are not intended to limit the present application.

**[0025]** In the description of the present application, it should be noted that the fixed connection described in the present application can be a detachable fixed connection or an integrated fixed connection; the indicated orientation or positional relationship is based on the positional relationship shown in the accompanying drawings, which is only for the purpose of facilitating and simplifying the descriptions, rather than indicating or implying that the referred apparatus or element has to have a particular orientation or be constructed and operated in a particular orientation, and therefore, such terms should not be construed as limitations on the present application.

**[0026]** The terms "first" and "second" are used for descriptive purposes only and are not intended to imply relative importance.

**[0027]** An embodiment of the present application provides a transition coupler and a coupling method therefor, which are applicable to coupling with train couplers in which coupler hooks are inserted laterally into the train couplers, for example, to coupling with a BSI coupler. In the present embodiment, the BSI coupler is taken as an example to describe the structure of the transition coupler and the coupling method.

**[0028]** In the description of a coupler or components of the coupler in the present application, the term "front" refers to a direction facing an opposite coupler, and the term "rear" refers to a direction away from the opposite coupler.

**[0029]** First, the structure of the BSI coupler 100 will be described with reference to Fig. 1a and Fig. 1b.

**[0030]** The BSI coupler 100 comprises a coupler head 110. One end surface (specifically, a front end surface) of the coupler head 110 serves as a coupler coupling surface 111 of the BSI coupler. A male cone 112 of the BSI coupler and a female cone 113 of the BSI coupler are formed on one side (specifically, a front side) of the coupler coupling surface 111. A rear end of the coupler head 110 forms a coupler rear 120 of the BSI coupler. Between the coupling surface 111 and the coupler rear 120 is a coupler head housing of the BSI coupler.

**[0031]** Further referring to Figs. 4a to 5b, a cavity 114 for accommodating the coupler hook is formed inside the male cone 112 of the BSI coupler 100, and a coupler hook 130 of the BSI coupler is mounted in the cavity 114. The coupler hook 130 comprises a coupler hook rod 131 and a coupler hook head 132. One end of the coupler hook rod 131 is connected to an uncoupling handle 150, while the other end of the coupler hook rod 131 is provided with the coupler hook head 132. The coupler hook head 132 extends out from the cavity 114 toward an opening of the female cone 113 of the BSI coupler. The entire coupler hook 130 can be moved by pulling the uncoupling handle 150, causing the coupler hook head 132 to retract into the cavity 114. Specifically, a spring 140 is mounted on the coupler hook rod 131, and the spring 140 is compressed when pulling the coupler hook rod 131, causing the coupler hook head 132 to retract. Upon releasing the uncoupling handle 150, the spring 140 restores to its original length, causing the coupler hook head 132 to extend out.

**[0032]** In order to position the coupling between the BSI coupler and the transition coupler, positioning structures are designed on the BSI coupler, which is described in detail as follows.

**[0033]** A bottom of the female cone 113 of the BSI coupler 100 extends forward of the coupler head 1 to form a plate-shaped structure 115, and a first positioning protrusion 116 is provided on an upper surface of the plate-shaped structure 115. A second positioning protrusion 117 is provided at a bottom of the male cone 112. A stepped transition structure is formed between the plate-shaped structure 115 and the male cone 112. That is, the plate-shaped structure 115 extends further downward relative to the male cone 112, and a side surface of the stepped transition structure facing a direction the male cone 112 is a stepped transition surface, on which a third positioning protrusion 118 is provided. In other words, a third positioning protrusion 118 is formed on a side surface of the plate-shaped structure 115 facing a space below the male cone 112. Optionally, the above-mentioned first positioning protrusion 116, second positioning protrusion 117, and third positioning protrusion 118 are all protruding blocks that protrude from the respective surfaces. Optionally, a guiding inclined surface 119 is formed at a front side of each protruding block to connect the corresponding surface on which the protruding block is located and a highest position of the protruding block.

**[0034]** An inclined surface 133 is formed on a front side of the coupler hook head 132, and the inclined surface 133 of the coupler hook head is inclined in a direction away from the transition coupler. The inclined surface 133 of the coupler hook head makes the head of the coupler hook head longer, and a coupling hook is formed on a rear side of the inclined surface 133.

**[0035]** The embodiments of the present application provides a transition coupler for coupling with train couplers in which coupler hooks are inserted laterally into the train couplers (for example, the coupling with the above-mentioned BSI coupler) , with reference to Figs. 2a-2d.

**[0036]** The transition coupler 200 comprises a coupler head 210 of the transition coupler and a coupler rear 220 of the transition coupler, and a coupling surface 211 of the

transition coupler is formed on a side (i.e., a front side) of the coupler head 210 coupled with the BSI coupler 100. A coupler head housing 212 is provided between the coupling surface 211 of the transition coupler and the coupler rear 220 of the transition coupler. A coupling link pin hole 221 is provided in the coupler rear 220 of the transition coupler. A weight-reducing hole 213 is provided in the coupler head housing 212 of the transition coupler.

**[0037]** A coupler hook structure 230 is formed on the coupling surface 211 of the transition coupler, and is configured to be coupled with the coupler tongue of a train coupler, i.e., a coupler tongue 130 of the BIS coupler in this embodiment.

**[0038]** A female cone structure 240 is formed on the coupling surface 211 of the transition coupler, and is configured to accommodate the male cone 112 of the train coupler, i.e., the male cone 112 of the BSI coupler in this embodiment; the female cone structure 240 comprises a female cone cavity 241 formed from the coupling surface 211 of the transition coupler toward an interior of the coupler head housing 212 of the transition coupler 200.

**[0039]** In some embodiments of the present application, the structure of the coupler hook of the transition coupler is as follows.

**[0040]** The coupler hook structure 230 comprises a male cone 231 of the transition coupler formed on the coupling surface 211 the transition coupler, and the male cone 231 protruding relative to the coupling surface 211. A coupler hook block 232 is provided on a side surface of the male cone 231 of the transition coupler that adjacent to the female cone structure 240. The coupler hook block 232 has an inclined surface 2321 of the coupler hook block, with a wider end of the inclined surface 2321 is adjacent to the coupling surface 211 of the transition coupler. An edge of the inclined surface 2321 at a side adjacent to the coupling surface 211 of the transition coupler is retracted toward a side away from the female cone structure 240 to form a structure similar to a clamping platform, thereby forming a coupler hook of the transition coupler.

**[0041]** In the above embodiment, a coupler hook block 232 is fixedly provided on the side surface of the male cone 231 of the transition coupler that adjacent to the female cone structure 240. An inclined surface 2321 is provided on a front side of the coupler hook block 232, and the inclined surface 2321 of the coupler hook block is inclined from front toward rear of the transition coupler 200 in a direction away from the male cone 231 of the transition coupler. A surface behind the inclined surface 2321 of the coupler hook block is connected to a sidewall of the female cone cavity 241 to form a coupler hook of the transition coupler. An inclination of the inclined surface 2321 of the coupler hook block of the transition coupler is complementary to an inclination of the inclined surface 133 of the coupler hook head of the BSI coupler 100.

**[0042]** During coupling operation, the coupling surface 211 of the transition coupler and the coupling surface 111 of the BSI coupler are opposite to each other, and the uncoupling handle 150 of the BSI coupler is pulled. The inclined surface 2321 of the coupler hook block of the transition coupler faces the inclined surface 133 of the coupler hook head of the BSI coupler, with their inclinations match each other. Through the cooperation of the two inclined surfaces, the coupler hook block 232 of the transition coupler 200 and the coupler hook head 132 of the BSI coupler are pressed against each other and mutually guided, causing the spring 140 to be compressed. The transition coupler 200, under the guidance of the two inclined surfaces, slides behind the coupler hook head 132 of the BSI coupler 100, such that the coupler hooks of the two couplers interlock with each other, thereby completing the coupling.

**[0043]** In some embodiments of the present application, a first auxiliary positioning block 251 is provided at a bottom of the male cone 231 of the transition coupler, and the first auxiliary positioning block 251 is protruded relative to a bottom surface of the transition coupler male cone 231.

**[0044]** In some embodiments of the present application, a first auxiliary positioning block 251 is provided at a bottom of the coupler head 210 of the transition coupler corresponding to the male cone 231 of the transition coupler, and the first auxiliary positioning block 251 is protruded relative to a bottom surface of the coupler head 210 of the transition coupler.

**[0045]** During the coupling process between the transition coupler 200 and the BSI coupler 100, the male cone 231 of the transition coupler extends into an interior of the female cone 113 of the BSI coupler 100, and the first auxiliary positioning block 251 formed on the plate-shaped structure 115 in front of the coupler head 110 of the BSI coupler 100 cooperates with the first positioning protrusion 116 formed on the coupler head 110 of the BSI coupler 100. That is, the two protruding blocks are in abutment with each other, completing limit positioning between the two couplers on a first side in the vertical direction.

**[0046]** In some embodiments of the present application, a second auxiliary positioning block 252 is provided on an inner surface of a bottom of the female cone cavity 241 of the transition coupler 200, and the second auxiliary positioning block 252 is protruded into the female cone cavity 241.

**[0047]** During the coupling process between the transition coupler 200 and the BSI coupler 100, the male cone 112 of the BSI coupler 100 extends into the female cone cavity 241 of the transition coupler 200, and the second positioning protrusion 117 provided at the bottom of the male cone 112 of the BSI coupler 100 cooperates with the second auxiliary positioning block 252 of the transition coupler 200. That is, the two protruding blocks are in abutment with each other, completing limit positioning between the two couplers on a second side in the vertical direction.

**[0048]** In some embodiments of the present applica-

tion, a bottom of the female cone cavity 241 of the transition coupler 200 extends further downward relative to a bottom of the male cone 231 of the transition coupler. A transition structure 260 connecting the bottom of the female cone cavity 241 and the bottom of the male cone 231 of the transition coupler is formed between the female cone structure 240 and the coupler hook structure 230. A side surface of the transition structure 260 facing a space below the male cone 231 of the transition coupler is a transition side surface 261. Specifically, the transition structure 260 is an arcuate structure transitioning from the bottom of the male cone 231 of the transition coupler to the bottom of the female cone cavity 241. One side surface of the arcuate structure constitutes an inner wall of the female cone cavity 241, and an opposite side surface of the arcuate structure is the transition side surface 261. During the coupling process between the transition coupler 200 and the BSI coupler 100, the transition side surface 261 on the transition coupler 200 cooperates with the third positioning protrusion 118 on the BSI coupler 100. That is, the transition side surface 261 and the third positioning protrusion 118 are in abutment with each other, completing limit positioning between the two couplers in the horizontal direction.

**[0049]** In some embodiments of the present application, an extension block 233 facing a direction of the female cone structure 240 is provided on the male cone 231 of the transition coupler. When the transition coupler 200 is coupled with the BSI coupler 100, a side surface of the extension block 233 facing a direction of the female cone structure 240 cooperates with a side surface of the male cone 112 of the BSI coupler, i.e., the two side surfaces are in abutment with each other, thereby completing limit positioning between the two couplers in the horizontal direction.

**[0050]** In some embodiments, an extension block 233 is provided on the male cone 231 of the transition coupler. The extension block 233 is located on the same side as coupler hook block 232 and is protruded relative to the male cone 231of the transition coupler. A fourth positioning protrusion 1121 is protrudingly provided on a side surface of the male cone 112 that adjacent to the female cone 113. When the transition coupler 200 is coupled with the BSI coupler 100, a side surface of the extension block 233 cooperates with a side surface of the fourth positioning protrusion 1121 of the BSI coupler 100, that is, the two side surfaces are in abutment with each other, thereby completing limit positioning between the two couplers in the horizontal direction.

**[0051]** Through coordination of the above four sets of positioning structures, positioning between the transition coupler and the BSI coupler can be achieved in two directions of the horizontal dimension and two directions of the vertical dimension, respectively, thereby ensuring the stability of coupling between the two couplers.

**[0052]** Since the structure of the coupler hook of the BSI coupler is significantly different from those of other types of couplers, the uncoupling operation needs to be performed laterally on the coupler, and the uncoupling handle 150 occupies the lateral space of the coupler. Therefore, during the coupling process with the BSI coupler, it is necessary to consider how the female cone structure 240 of the transition coupler 200 cooperates with the uncoupling operation of the uncoupling handle 150, so as to avoid interference on the coupling.

**[0053]** A shape of the female cone cavity 241 of the transition coupler 200 matches an external profile of the male cone 112 of the BSI coupler 100, thereby better adapting to the coupling with the male cone 112 of the BSI coupler 100. In the present embodiment, the male cone 112 of the BSI coupler 100 is formed as an approximately conical structure, and correspondingly, the female cone cavity 241 of the transition coupler 200 is also formed as an approximately conical structure.

**[0054]** A recessed notch 214 extending toward the coupler rear 220 of the transition coupler is formed on a sidewall, away from the coupler hook block 232, of the female cone cavity 241 of the female cone structure 240 of transition coupler 200. Specifically, a recessed notch 214 is formed on an outer side of the female cone cavity 241 of the transition coupler 200, so as to accommodate the uncoupling handle 150 during the coupling of the transition coupler 200 with the BSI coupler 100. During the coupling process between the transition coupler 200 and the BSI coupler 100, the uncoupling handle 150 is positioned in the concave notch 214, thereby avoiding interference between the female cone cavity 241 and the uncoupling handle 150 during movement.

**[0055]** Another aspect of the present application provides a coupling method for the above-mentioned transition coupler. In summary, the method for coupling the transition coupler 200 to the BSI coupler 100 is as follows.

**[0056]** The coupler hook block 232 of the transition coupler 200 is in contact with the coupler hook head 132 of the BSI coupler 100; the transition coupler 200 and the BSI coupler 100 move toward each other, and the coupler hook block 232 of the transition coupler 200 and the coupler hook head 132 of the BSI coupler 100 are pressed against each other, causing the coupler hook head 132 of the BSI coupler 100 to retract; the coupler hook head 132 of the transition coupler 200 slides behind the coupler hook head 132 of the BSI coupler 100, and pressure applied to the coupler hook head 132 of the BSI coupler 100 is disappeared, thus the coupler hook head 132 of the BSI coupler 100 extends out, thereby completing the coupling .

**[0057]** In some embodiments, the coupling method further comprises the following steps: during a coupling process between the transition coupler 200 with the BSI coupler 100, the inclined surface 2321 of the coupler hook block of the transition coupler 200 is in contact with the inclined surface 133 of the coupler hook head of the BSI coupler 100; while the coupler hook block 232 of the transition coupler 200 and the coupler hook head 132 of the BSI coupler 100 are pressed against each other, the coupler hook block 232 of the transition coupler 200 is

guided to the rear side of the coupler hook head 132 of the BSI coupler 100 through cooperation of the inclined surface 2321 of the coupler hook block and the inclined surface 133 of the coupler hook head, thereby completing the coupling.

**[0058]** In some embodiments, the coupling method further comprises the following steps: during the coupling process between the transition coupler 200 and the BSI coupler 100, the respective sets of positioning structures cooperate to perform positioning.

**[0059]** Specifically, during the coupling process between the transition coupler 200 and the BSI coupler 100, the first auxiliary positioning block 251 of the transition coupler 200 cooperates with the first positioning protrusion 116 of the BSI coupler 100 for vertical positioning; the second auxiliary positioning block 252 of the transition coupler 200 cooperates with the second positioning protrusion 117 of the BSI coupler 100 for vertical positioning; the transition side surface 261 of the transition coupler 200 cooperates with the third positioning protrusion 118 for horizontal positioning; and the extension block 233 of the transition coupler 200 cooperates with the fourth positioning protrusion 1121 of the BSI coupler 100 for horizontal positioning.

**[0060]** Hereinafter, with respect to the above-described coupling process, the principle of coupling and uncoupling between the transition coupler 200 and the BSI coupler 100 is further detailed.

**[0061]** Compared with the BSI coupler 100, the transition coupler 200 eliminates an extendable movable coupler hook and is designed with a fixed coupler hook for uncoupling. During coupling, the inclined surface 2321 of the fixed coupler hook block 232 of the transition coupler 200 is pressed against the inclined surface 133 of coupler hook head of the BSI coupler 100. By compressing the spring 140 of the BSI coupler 100, the coupler hook block 232 of the transition coupler 200 guides the movement of the BSI coupler 100 until the coupler hooks of the two couplers engage with each other. After the coupler hook head 132 of the BSI coupler 100 and the coupler hook block 232 of the transition coupler 200 are engaged with each other, the spring 140 of the BSI coupler 100 returns to its original position, thereby achieving coupling lock between the two couplers. At this point, the coupling surface 211 of the transition coupler is in contact with the coupling surface 111 of the BSI coupler.

**[0062]** The transition coupler 200 and BSI coupler 100 are coupled in place under the limit positioning of the four sets of positioning structures between the transition coupler 200 and BSI coupler 100. During uncoupling of the transition coupler 200, the coupler hook rod 131 is lifted by operating the uncoupling handle 150 of the BSI coupler 100, causing the coupler hooks of the two couplers to separate. The two couplers are then slowly pulled apart, allowing the positioning structures and the coupling surfaces of the two couplers to disengage, thereby completing the uncoupling of the transition coupler 200.

**[0063]** The specific operation process of coupling and uncoupling is further detailed as follows.

**[0064]** Coupling process: the transition coupler 200 moves toward the BSI coupler 100, the male cone 231 of the transition coupler and the female cone 113 of the BSI coupler 100 guide each other, and the female cone cavity 241 of the transition coupler 200 and the male cone 112 of the BSI coupler 100 guide each other. The male cone 231 of the transition coupler enters the female cone 113 of the BSI coupler, and, correspondingly, the male cone 112 of the BSI coupler 100 enters the female cone cavity 241 of the transition coupler 200, as shown in Fig. 4a. As the two couplers continue to approach each other, the fixed coupler hook block 232 of the transition coupler 200 presses against the coupler hook head 132 of the BSI coupler 100, causing the coupler tongue rod 131 of the BSI coupler 100 to be pushed into the cavity 114 inside the male cone 112 of the BSI coupler 100. When the coupling surface 211 of transition coupler and the coupling surface 111 of the BSI coupler 100 approach each other and are about to contact, the fixed coupler hook block 232 of the transition coupler 200 slides behind the coupler hook head132 of the BSI coupler 100. At this point, the coupling surface 211 of the transition coupler and the coupling surface 111 BSI of the coupler are in close contact, and the coupler hook head 132 of the BSI coupler 100 is released from the pressing of the fixed coupler hook block 232 of the transition coupler 200 and springs back, thereby achieving coupling between the coupler hooks of the transition coupler 200 and the BSI coupler 100, as shown in Fig. 4b. In addition, under the limit positioning of the four sets of positioning structures, the transition coupler 200 and the BSI coupler 100 are coupled in place.

**[0065]** Uncoupling process: as shown in Fig. 5a, by pulling the uncoupling handle 150 of the BSI coupler 100, the coupler hook rod 131 of the BSI coupler 100 is retracted into the cavity 114 inside the male cone 112 of the BSI coupler 100. At this point, the coupler hooks of the transition coupler 200 and the BSI coupler 100 disengage from each other, releasing the limiting engagement, thereby completing the uncoupling of the couplers. After the two couplers are uncoupled, the transition coupler 200 can be pulled rearward to be separated from the BSI coupler 100, as shown in Fig. 5b.

**[0066]** The above description is only of the preferred embodiments of the present application and is not intended to limit the present application. Any modifications, equivalent substitutions and improvements made within the spirit and principles of the present application should fall within the scope of the present application.

## Claims

1. A transition coupler for coupling with a train coupler, the train coupler comprising a coupler head, a male cone and a female cone formed on the coupler head, a coupler hook is retractably provided on the male

cone toward the female cone; the transition coupler comprising:

a coupler head of the transition coupler and a coupler rear of the transition coupler: wherein a coupling surface of the transition coupler is formed on a side of the coupler head of the transition coupler coupled with the train coupler, and a coupler head housing is provided between the coupling surface of the transition coupler and the coupler rear of the transition coupler;
a coupler hook structure is formed on the coupling surface of the transition coupler, and is configured to be coupled with the coupler hook of the train coupler; the coupler hook structure comprises a male cone of the transition coupler formed on the coupling surface of the transition coupler, and a coupler hook block is provided on a side surface of the male cone of the transition coupler adjacent to a female cone structure;
the female cone structure is formed on the coupling surface of the transition coupler, and is configured to accommodate the male cone of the train coupler; the female cone structure comprises a female cone cavity formed from the coupling surface of the transition coupler toward an interior of the coupler head housing.

**2.** The transition coupler according to claim 1, **characterized in that**, an inclined surface is formed on the coupler hook block, a wider end of the inclined surface is adjacent to the coupling surface of the transition coupler, and an edge of the inclined surface at a side adjacent to the coupling surface of the transition coupler is retracted toward a side away from the female cone structure to form a coupler hook of the transition coupler.

**3.** The transition coupler according to claim 1, **characterized in that**, an inclined surface is provided on a front side of the coupler hook block, and the inclined surface of the coupler hook block is inclined from front toward rear of the transition coupler in a direction away from the male cone of the transition coupler, and a surface behind the inclined surface of the coupler hook block is connected to a sidewall of the female cone cavity to form a coupler hook of the transition coupler.

**4.** The transition coupler according to claim 2 or claim 3, **characterized in that**, a bottom of the female cone of the train coupler extends forward of the coupler head of the train coupler to form a plate-shaped structure, and a first positioning protrusion is provided on an upper surface of the plate-shaped structure; a first auxiliary positioning block is provided at a bottom of the male cone of the transition coupler; when the transition coupler is coupled with the train coupler, the first auxiliary positioning block of the transition coupler cooperates with the first positioning protrusion of the train coupler for positioning.

**5.** The transition coupler according to claim 2 or 3, **characterized in that**, a second positioning protrusion is provided at a bottom of the male cone of the train coupler; a second auxiliary positioning block is provided on an inner surface of a bottom of the female cone cavity of the transition coupler, and the second auxiliary positioning block is protruded into the female cone cavity; when the transition coupler is coupled with the train coupler, the male cone of the train coupler extends into the female cone cavity of the transition coupler, and the second auxiliary positioning block cooperates with the second positioning protrusion for positioning.

**6.** The transition coupler according to claim 2 or 3, **characterized in that**, a bottom of the female cone of the train coupler extends forward of the coupler head of the train coupler to form a plate-shaped structure, and a third positioning protrusion is formed on a side surface of the plate-shaped structure facing a space below the male cone of the train coupler; a bottom of the female cone cavity of the transition coupler extends further downward relative to a bottom of the male cone of the transition coupler, and a transition structure connecting the bottom of the female cone cavity and the bottom of the male cone of the transition coupler is formed between the female cone structure and the coupler hook structure, a side surface of the transition structure facing a space below the male cone of the transition coupler is a transition side surface; when the transition coupler is coupled with the train coupler, the transition side surface of the transition coupler cooperates with the third positioning protrusion of the train coupler for positioning.

**7.** The transition coupler according to claim 2 or 3, **characterized in that**, an extension block facing a direction of the female cone structure is provided on the male cone of the transition coupler; when the transition coupler is coupled with the train coupler, a side surface of the extension block facing the direction of the female cone structure cooperates with a side surface of the male cone of the train coupler for positioning.

**8.** The transition coupler according to claim 1, **characterized in that**, a shape of the female cone cavity of the transition coupler matches an external profile of the male cone of the train coupler.

**9.** The transition coupler according to claim 1 or claim 8, **characterized in that**, a recessed notch extending toward the coupler rear of the transition coupler is

formed on a sidewall, away from the coupler hook block, of the female cone cavity of the female cone structure of the transition coupler; when the transition coupler is coupled with the train coupler, an uncoupling handle of the train coupler is accommodated in the recessed notch.

**10.** A coupling method for a transition coupler, applied to the transition coupler according to any one of claims 1 to 9, comprising following steps:
the coupler hook block of the transition coupler contacting the coupler hook of the train coupler; the transition coupler and the train coupler moving toward each other, and the coupler hook block of the transition coupler and the coupler hook of the train coupler being pressed against each other, causing the coupler hook of the train coupler to retract; the coupler hook block of the transition coupler sliding behind the coupler hook of the train coupler, and pressure applied to the coupler hook of the train coupler being disappeared, so that the coupler hook of the train coupler extends out and limits the coupler hook block of the transition coupler, thereby completing coupling.

**11.** The coupling method for the transition coupler according to claim 10, **characterized in that**, the coupler hook of the train coupler comprises a coupler hook rod and a coupler hook head provided at an end of the coupler hook rod, an inclined surface is formed on a side of the coupler hook head facing the transition coupler, and the inclined surface of the coupler hook head is inclined in a direction away from the transition coupler; an inclined surface of the coupler hook block is provided on a front side of the coupler hook block, the inclined surface of the coupler hook block is inclined from front toward rear of the transition coupler in a direction away from the male cone of the transition coupler, the inclined surface of the coupler hook head and the inclined surface of the coupler hook block having complementary inclinations;
the coupling method further comprises following steps: during the coupling between the transition coupler and the train coupler, the inclined surface of the coupler hook block of the transition coupler is in contact with the inclined surface of the coupler hook head of the train coupler, in a process of the coupler hook block of the transition coupler and the coupler hook head of the train coupler pressing against each other, the coupler hook block of the transition coupler is guided to a rear side of the coupler hook head of the train coupler through cooperation of the inclined surface of the coupler hook block and the inclined surface of the coupler hook head, thereby completing the coupling.

**12.** The coupling method for the transition coupler according to claim 10, **characterized in that**, a bottom of the female cone of the train coupler extends forward of the coupler head of the train coupler to form a plate-shaped structure, a first positioning protrusion is provided on an upper surface of the plate-shaped structure, and a first auxiliary positioning block is provided at a bottom of the male cone of the transition coupler;
the coupling method further comprises following steps: during the coupling between the transition coupler and the train coupler, the male cone of the transition coupler extends into an interior of the female cone of the train coupler, and the first auxiliary positioning block and the first positioning protrusion cooperate to position the train coupler and the transition coupler in a vertical direction.

**13.** The coupling method for the transition coupler according to claim 10, **characterized in that**, a second positioning protrusion is provided at a bottom of the male cone of the train coupler; a second auxiliary positioning block is provided on an inner surface of a bottom of the female cone cavity of the transition coupler, and the second auxiliary positioning block is protruded into the female cone cavity;
the coupling method further comprises following steps: during the coupling between the transition coupler and the train coupler, the male cone of the train coupler extends into the female cone cavity of the transition coupler, and the second positioning protrusion and the second auxiliary positioning block cooperate to position the train coupler and the transition coupler in a vertical direction.

**14.** The coupling method for the transition coupler according to claim 10, **characterized in that**, a bottom of the female cone of the train coupler extends forward of the coupler head of the train coupler to form a plate-shaped structure, a third positioning protrusion is formed on a side surface of the plate-shaped structure facing a space below the male cone of the train coupler; a bottom of the female cone cavity of the transition coupler extends further downward relative to a bottom of the male cone of transition coupler, a transition structure connecting the bottom of the female cone cavity and the bottom of the male cone of the transition coupler is formed between the female cone structure and the coupler hook structure, and a side surface of the transition structure facing a space below the male cone is a transition side surface;
the coupling method further comprises following steps: during the coupling between the transition coupler and the train coupler, the transition side surface on the transition coupler cooperates with the third positioning protrusion on the train coupler to perform positioning in a horizontal direction.

**15.** The coupling method for the transition coupler according to claim 10, **characterized in that**, an extension block facing a direction of the female cone structure is provided on the male cone of the transition coupler;
the coupling method further comprises following steps: during the coupling between the transition coupler and the train coupler, a side surface of the extension block facing the direction of the female cone structure cooperates with a side surface of the male cone of the train coupler to perform positioning in a horizontal direction.

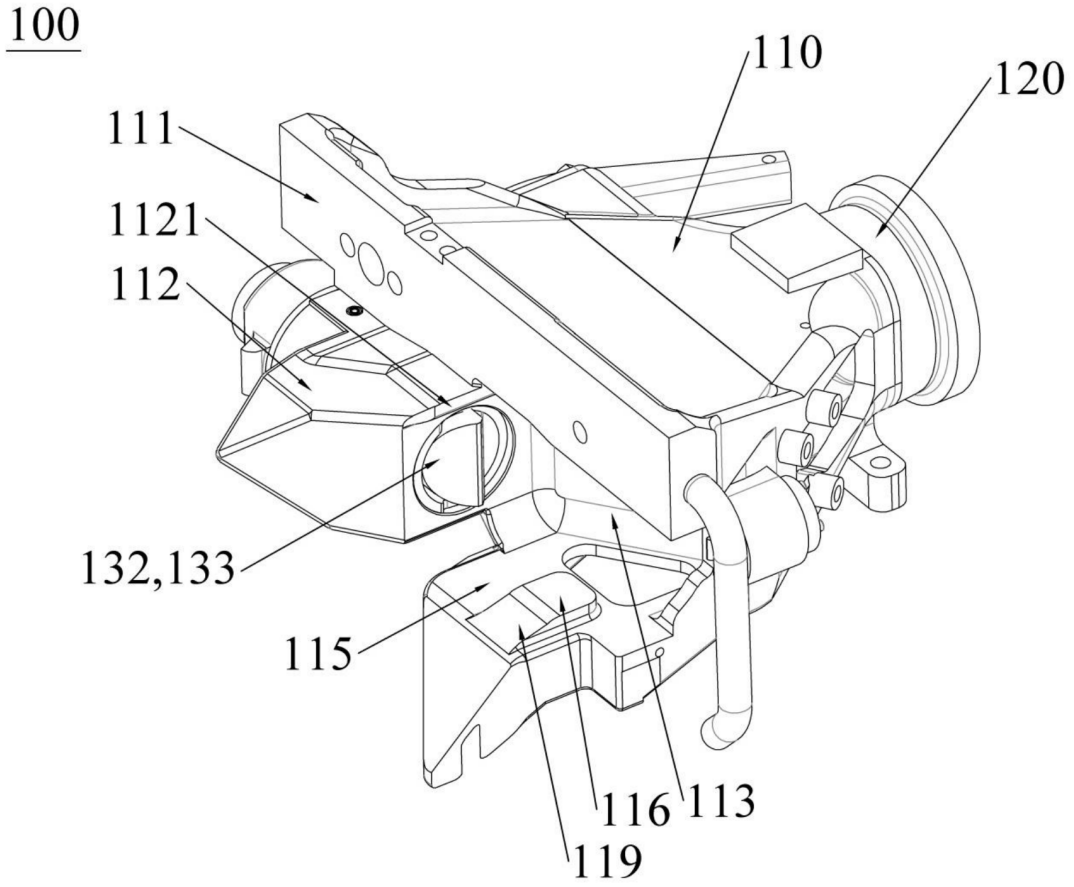
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Fig. 1a

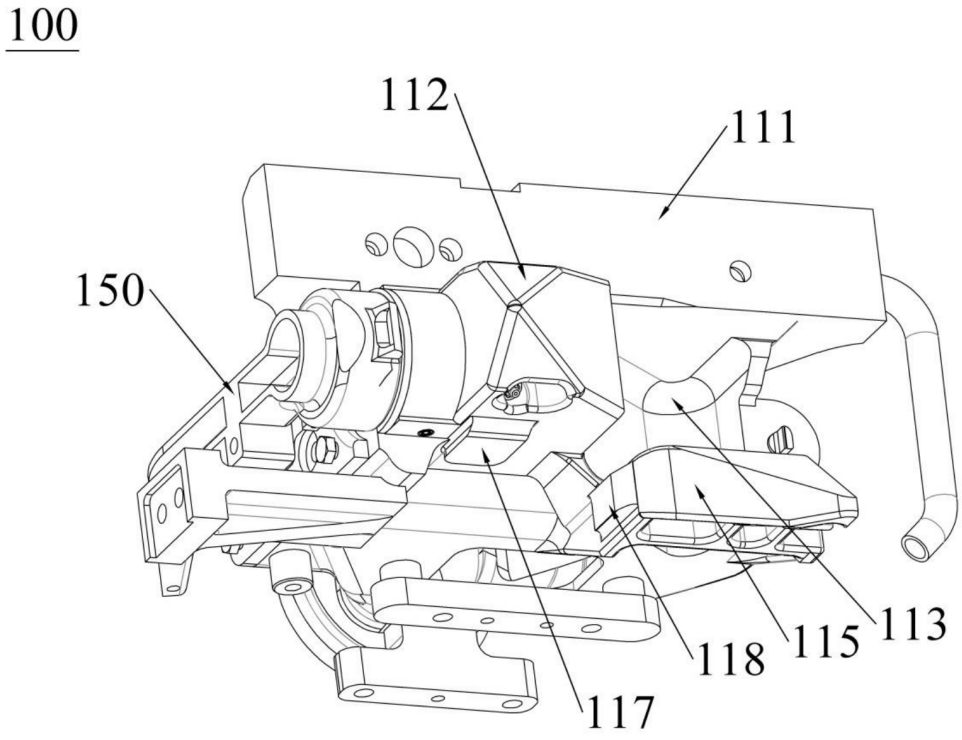
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Fig. 1b

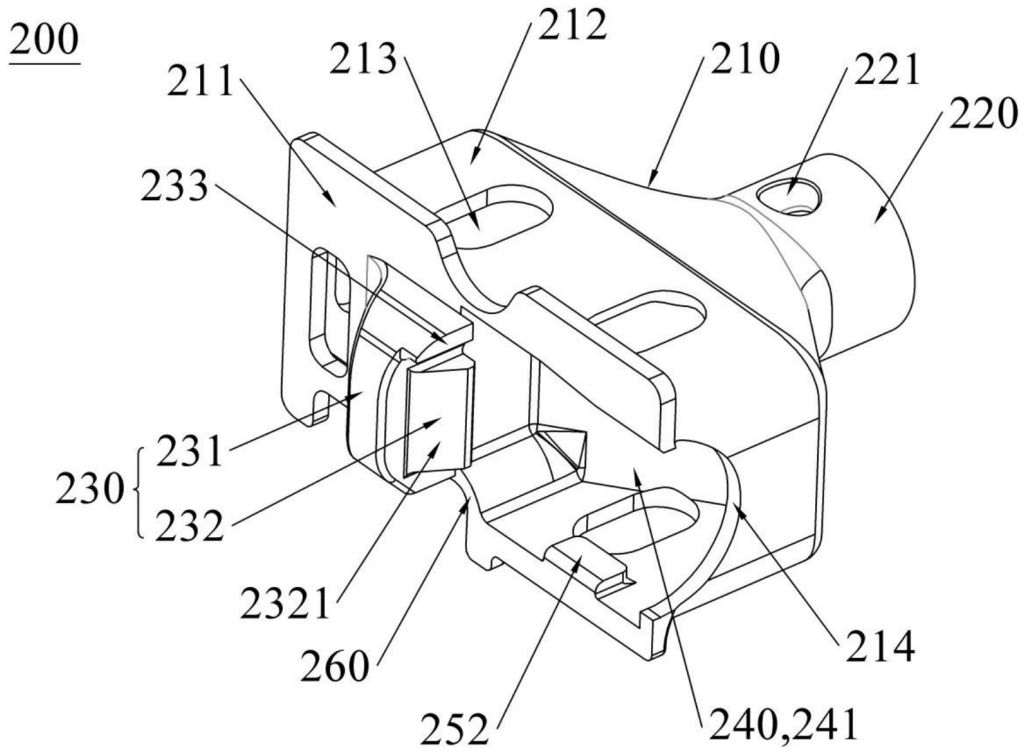
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Fig. 2a

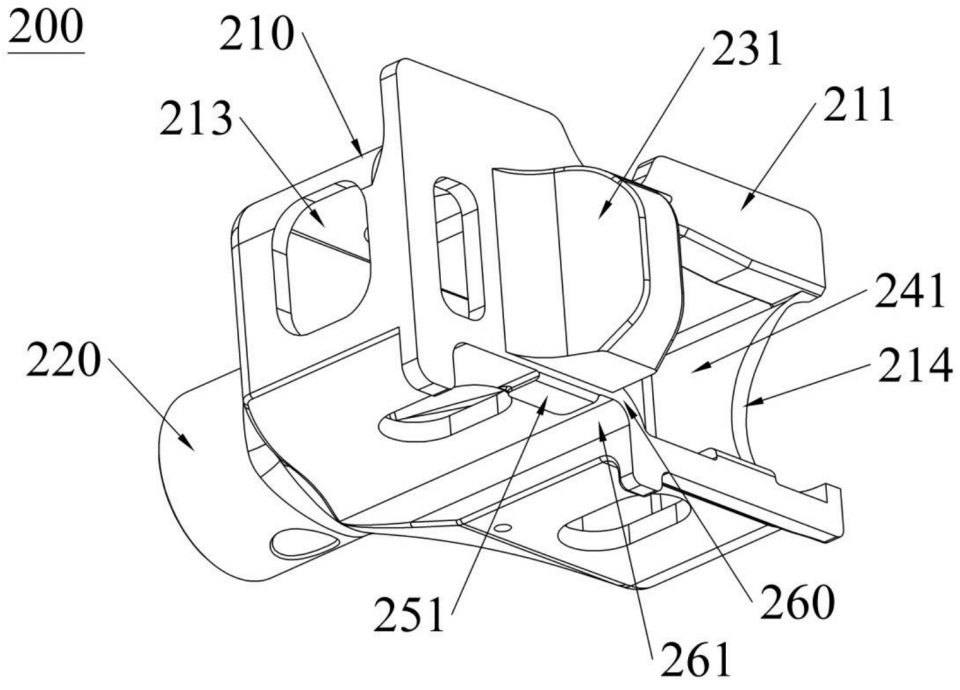
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Fig. 2b

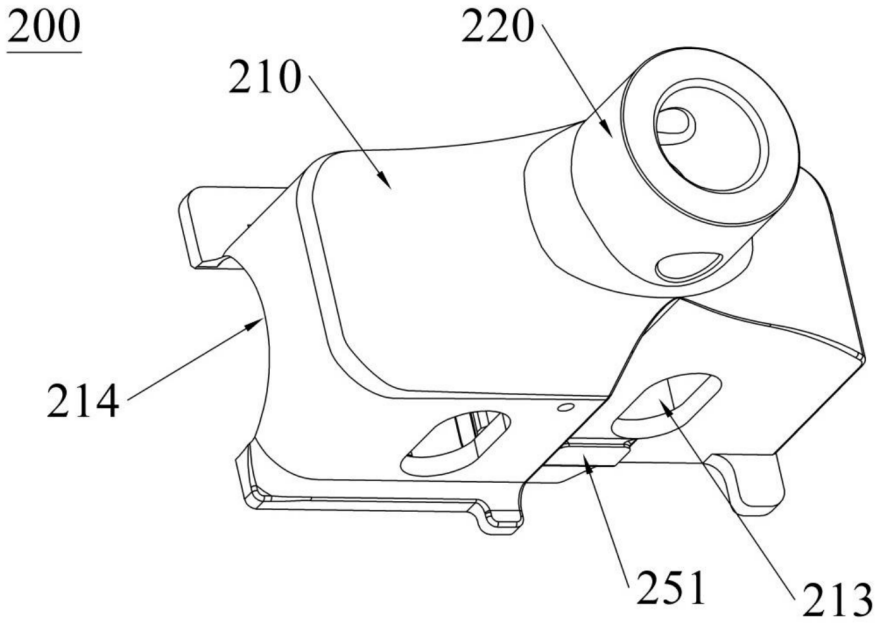


Fig. 2c

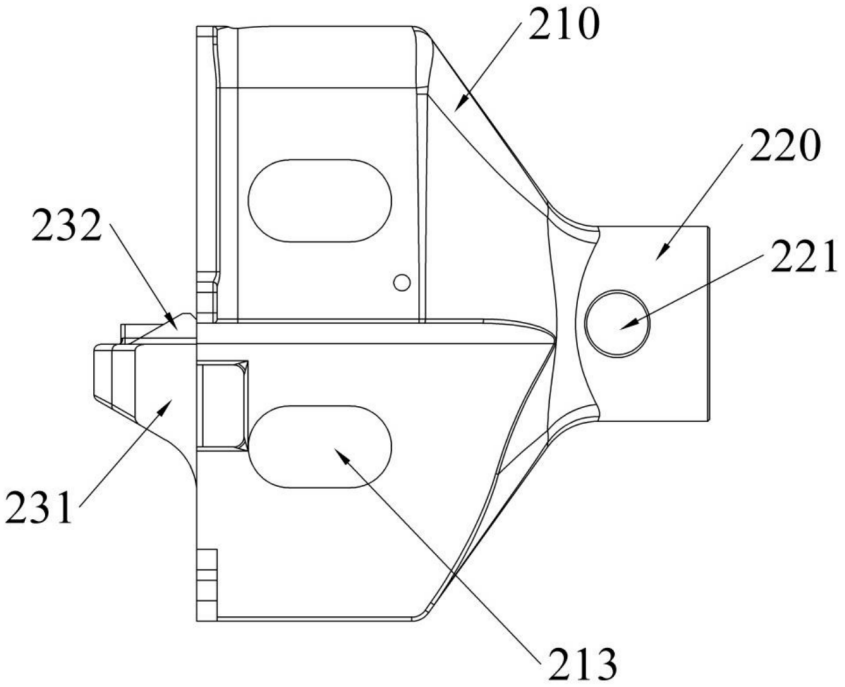


Fig. 2d

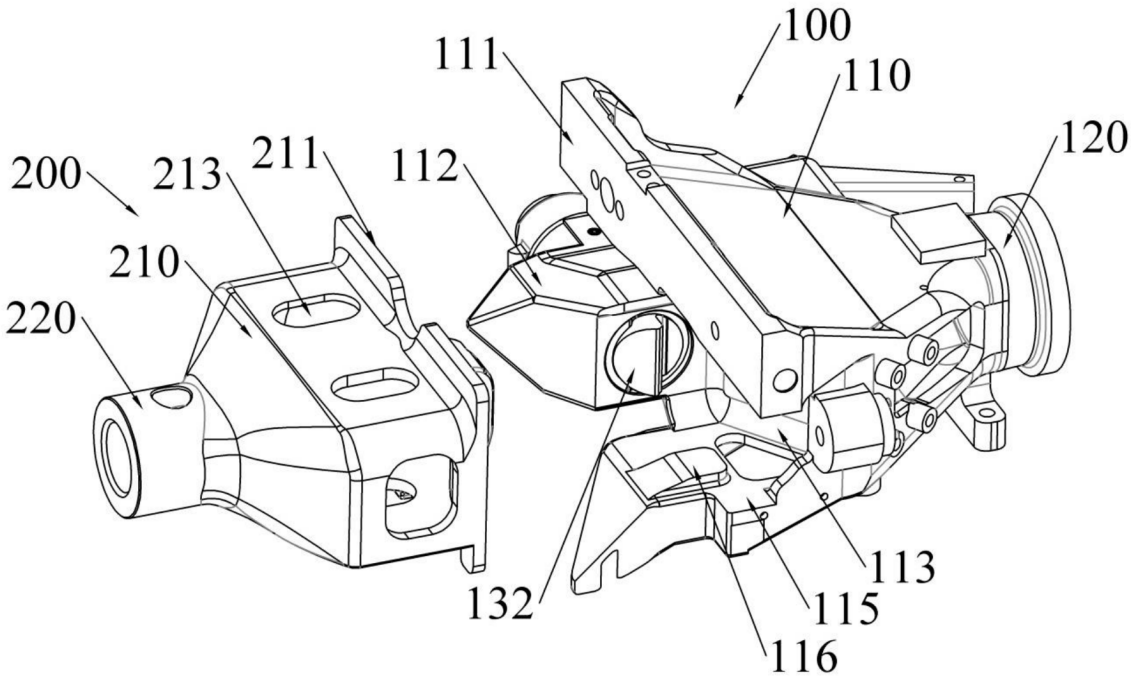
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Fig. 3

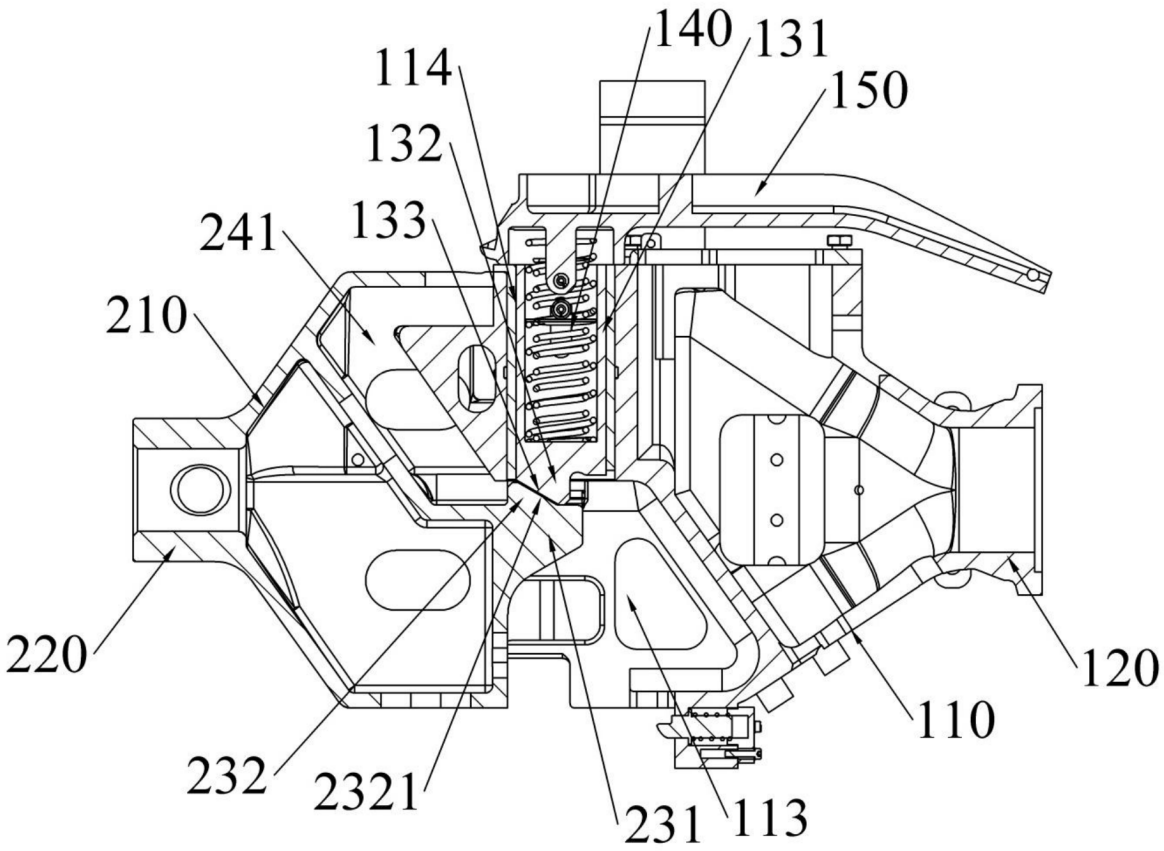
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Fig. 4a

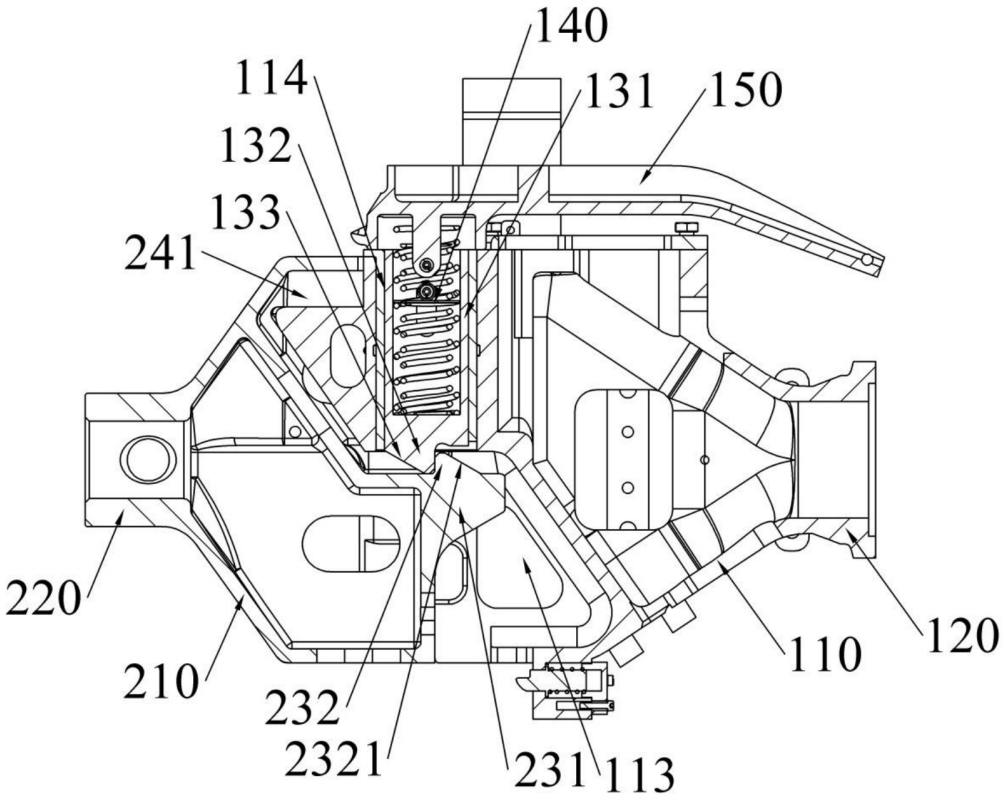
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Fig. 4b

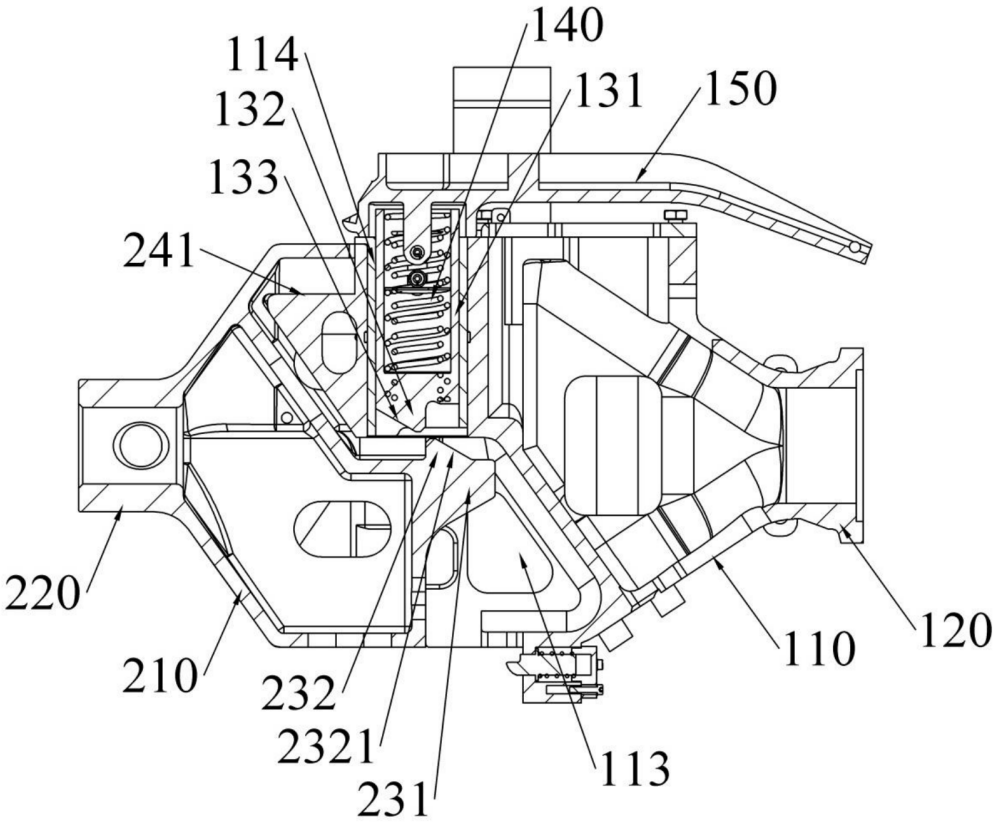
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Fig. 5a

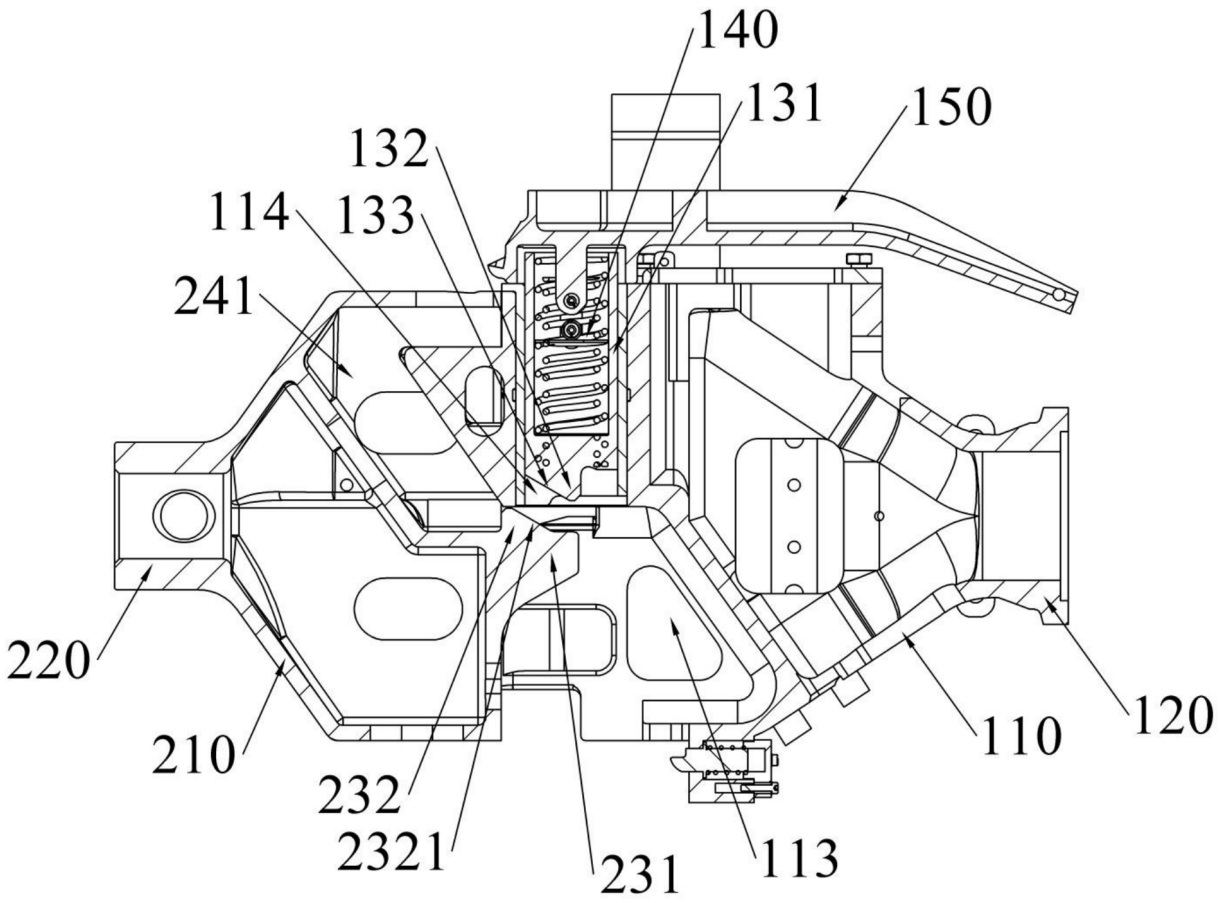


Fig. 5b

# INTERNATIONAL SEARCH REPORT

International application No.
**PCT/CN2024/126598**

**A. CLASSIFICATION OF SUBJECT MATTER**

B61G3/00(2006.01)i; B61G5/00(2006.01)i; B61G7/00(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)

B61G/-

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)

CNTXT, ENTXT, ENTXTC, CNKI: BSI型, 钩, 过渡, 卡合, 扣, 舌, 凹, 凸, 斜面, 定位, BSI, buckle, hook, snap, tongue, slope, concave, convex, position+

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| Y | DE 102018107900 A1 (VOITH PATENT GMBH) 11 October 2018 (2018-10-11) claims 1-7, and figures 1-14 | 1-3, 8-10 |
| Y | CN 112721989 A (CRRC QINGDAO SIFANG CO., LTD.) 30 April 2021 (2021-04-30) description, paragraphs 43-45, and figures 1-3 | 1-3, 8-10 |
| A | CN 111959554 A (CRRC QINGDAO SIFANG ROLLING STOCK RESEARCH INSTITUTE CO., LTD. et al.) 20 November 2020 (2020-11-20) entire document | 1-15 |
| A | CN 111655563 A (VOITH PATENT GMBH) 11 September 2020 (2020-09-11) entire document | 1-15 |
| A | CN 115675561 A (DELLNER COUPLERS AB) 03 February 2023 (2023-02-03) entire document | 1-15 |

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

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"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 |
|---|---|
| **09 June 2025** | **09 June 2025** |

| Name and mailing address of the ISA/CN | Authorized officer |
|---|---|
| **China National Intellectual Property Administration (ISA/CN)**<br>**China No. 6, Xitucheng Road, Jimenqiao, Haidian District, Beijing 100088** | Telephone No. |

Form PCT/ISA/210 (second sheet) (July 2022)

**INTERNATIONAL SEARCH REPORT**
**Information on patent family members**

International application No.
**PCT/CN2024/126598**

| Patent document cited in search report | | | Publication date (day/month/year) | Patent family member(s) | | | Publication date (day/month/year) |
|---|---|---|---|---|---|---|---|
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| CN | 112721989 | A | 30 April 2021 | CN | 112721989 | B | 11 October 2022 |
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| | | | | WO | 2019149464 | A1 | 08 August 2019 |
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| CN | 115675561 | A | 03 February 2023 | US | 2023027765 | A1 | 26 January 2023 |
| | | | | EP | 4122792 | A1 | 25 January 2023 |
| | | | | EP | 4122792 | B1 | 07 August 2024 |
| | | | | IN | 202214041017 | A | 12 January 2024 |

Form PCT/ISA/210 (patent family annex) (July 2022)

## REFERENCES CITED IN THE DESCRIPTION

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