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(71) Applicant: **CRRC Yangtze Group Co., Ltd.**
**Wuhan, Hubei 430212 (CN)**

(72) Inventors:
- **SU, Lijie**
  **Wuhan, Hubei 430212 (CN)**
- **HUANG, Meilin**
  **Wuhan, Hubei 430212 (CN)**
- **LIU, Aiwen**
  **Wuhan, Hubei 430212 (CN)**
- **MEI, Kun**
  **Wuhan, Hubei 430212 (CN)**
- **FENG, Ye**
  **Wuhan, Hubei 430212 (CN)**
- **YAO, Xiong**
  **Wuhan, Hubei 430212 (CN)**
- **HOU, Jianyun**
  **Wuhan, Hubei 430212 (CN)**
- **LUO, Hui**
  **Wuhan, Hubei 430212 (CN)**
- **CUI, Can**
  **Wuhan, Hubei 430212 (CN)**
- **KE, Xiaole**
  **Wuhan, Hubei 430212 (CN)**

(74) Representative: **Zaboliene, Reda**
**Metida**
**Business center Vertas**
**Gyneju str. 16**
**01109 Vilnius (LT)**

# (54) PIVOTAL SUSPENDED MONORAIL MULTI-TURNOUT SYSTEM AND AUXILIARY SWITCH DEVICE

(57) An auxiliary switching device of pivot-type suspended monorail multi-way turnout system. The auxiliary switching device includes: a first driving member (12), a bracket (21), a slide block (23), a slide rail (13), a second driving member (22) and a switching push head (24). An action end of the first driving member (12) is connected to the bracket (21) to drive the bracket (21) to move back and forth along a first axial direction. The slide block (23) is disposed on the bracket (21), and the slide block (23) is slidably connected onto the slide rail (13), so that the slide block (23) moves along the first axial direction. The second driving member (22) is disposed on the bracket (21). The switching push head (24) is connected to an action end of the second driving member (22), and is driven by the second driving member (22) to move along a second axial direction. The provided auxiliary switching device of pivot-type suspended monorail multi-way turnout system and can effectively improve efficiency, accuracy and reliability of switching operations. A pivot-type suspended monorail multi-way turnout system is also provided.

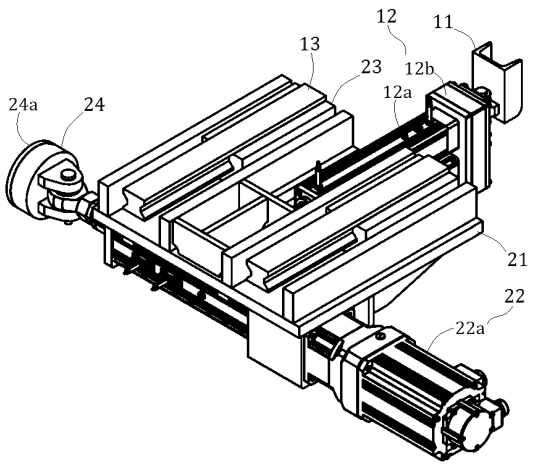


FIG. 1

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## Description

### CROSS-REFERENCE TO RELATED APPLICATIONS

**[0001]** This application claims the priority to the Chinese patent application No. 202210082451.9 filed on January 24, 2022 and entitled "Pivot-type suspended monorail multi-way turnout system and auxiliary switching device", the disclosure of which is hereby incorporated by reference in its entirety.

### TECHNICAL FIELD

**[0002]** The disclosure relates to the technical field of suspended monorail traffic, and particularly to a pivot-type suspended monorail multi-way turnout system and an auxiliary switching device.

### BACKGROUND

**[0003]** In current multi-way turnout systems of suspended monorail traffic, a driving mechanism is usually disposed on a turnout beam to drive it to deflect and butt a branch track beam. However, existing turnout beams, due to a heavy structure thereof, require a large power to be switched, have a long switching time, large control difficulty of precision of switching and alignment, and poor reliability.

### SUMMARY

**[0004]** The disclosure provides a pivot-type suspended monorail multi-way turnout system and an auxiliary switching device, which solve technical problems that multi-way turnout systems of suspended monorail traffic in the related art have a time-consuming switching operation and have a poor accuracy and reliability.

**[0005]** In one aspect of the disclosure, an auxiliary switching device is provided for a pivot-type suspended monorail multi-way switch system, including: a first driving member, a bracket, a slide block, a slide rail, a second driving member and a switching push head. An action end of the first driving member is connected to the bracket to drive the bracket to move back and forth along a first axial direction. The slide block is disposed on the bracket, and the slide block is slidably connected onto the slide rail, so that the slide block moves along the first axial direction. The second driving member is disposed on the bracket. The switching push head is connected to an action end of the second driving member, and is driven by the second driving member to move along a second axial direction.

**[0006]** In some embodiments, the first driving member includes: a first electric cylinder, whose action end is connected to the bracket.

**[0007]** In some embodiments, the first driving member further includes: a support of the first electric cylinder; the support of the first electric cylinder is disposed with a fixing structure for fixing onto a pier transverse beam of a turnout beam; a cylinder body of the first electric cylinder is disposed on the support of the first electric cylinder.

**[0008]** In some embodiments, the number of the slide rails is two or more, and two or more slide rails are arranged in parallel.

**[0009]** In some embodiments, the switching push head is pivotally connected to the action end of the second driving member.

**[0010]** In some embodiments, the second driving member includes: a second electric cylinder whose an action end is pivotally connected to the switching push head.

**[0011]** In another aspect of the disclosure, a pivot-type suspended monorail multi-way turnout system is provided, including: a turnout beam, a pier transverse beam, and the auxiliary switching devices according to any of the above embodiments. The turnout beam is movably connected onto the pier transverse beam, and is disposed with a contact portion to bear the switching push head. The first driving member and the slide rail are disposed on the pier transverse beam.

**[0012]** In some embodiments, the number of the auxiliary switching devices is two, and pushing directions of switching of two auxiliary switching devices are opposite.

**[0013]** In some embodiments, the switching push head is disposed with a buffer rubber pad.

**[0014]** In some embodiments, the turnout beam is disposed with a pushed pad that cooperates with the switching push head.

**[0015]** The pivot-type suspended monorail multi-way turnout system and auxiliary switching device in the disclosure are disposed with a first driving member and a slide rail that can be fixed to the pier transverse beam, so that a bracket can be slidably fixed on the slide rail and can be pushed and pulled as a load-bearing body of a driving body of switching to adjust a position of a force-applying body for switching, and therefore it is convenient to accurately pushing the turnout beam. The second driving member can use the bracket as the force-applying body, and use the bracket and the pier transverse beam connected thereto as a basis for applying force, and therefore the turnout beam can be pushed to move relative to the pier transverse beam, thereby realizing a movement of the turnout beam in a direction of switching, and therefore small-scale switching operations can be implemented to make up for inaccuracy and unreliable problems of conventional switching mechanisms, and in turn an efficiency of switching operations can be improved and a time consumption can be reduced.

### BRIEF DESCRIPTION OF DRAWINGS

**[0016]** In order to more clearly illustrate the technical solutions in the embodiments of this application, a brief introduction will be made below to the accompanying drawings needed to be used in the description of the embodiments. Obviously, the accompanying drawings in

the following description illustrate some embodiments of this application. For those skilled in the art, other accompanying drawings can also be obtained based on these accompanying drawings without exerting creative efforts.

FIG. 1 shows a schematic structural diagram of an auxiliary switching device according to some embodiments of the disclosure;

FIG. 2 is a schematic diagram of the auxiliary switching device in FIG. 1 in an assembly state from a first angle of view;

FIG. 3 is a schematic diagram of the auxiliary switching device in FIG. 2 in the assembly state from a second angle of view;

FIG. 4 shows a schematic diagram of the auxiliary switching device according to some embodiments of the disclosure in a working state; and

FIG. 5 shows a schematic diagram of the auxiliary switching device according to some embodiments of the disclosure in a standby state.

## DESCRIPTION OF EMBODIMENTS

**[0017]** The technical solutions in the embodiments of this application will be clearly and completely described below with reference to the accompanying drawings in the embodiments of this application. Obviously, the described embodiments are only some embodiments of this application, rather than all embodiments. Based on the embodiments in this application, all other embodiments obtained by those skilled in the art without creative efforts fall within the scope of protection of this application.

**[0018]** It should be noted that all directional indications in the embodiments of this application are only used to explain relative positional relationships, movement conditions and so on among various components in a specific posture. If the specific posture changes, the directional indications also change accordingly.

**[0019]** The following disclosure provides many different embodiments or examples for implementing different structures of this application. To simplify the disclosure of this application, the components and arrangements of specific examples are described below. Of course, the specific examples are merely for illustrating and are not intended to limit the application. Furthermore, though reference numbers and/or reference letters may be repeated in different examples in the disclosure, such repetition is for the purposes of simplicity and clarity and does not by itself indicate a relationship between various embodiments and/or arrangements discussed. In addition, this application provides examples of various specific processes and materials, but those skilled in the art will recognize applications of other processes and/or uses of other materials.

**[0020]** The disclosure provides a pivot-type suspended monorail multi-way turnout system and an auxiliary switching device, to solve technical problems that multi-way turnout systems of suspended monorail traffic in the related art have time-consuming switching operations and have poor accuracy and reliability.

**[0021]** In order to better understand technical solutions of the disclosure, the technical solutions will be described in detail below with reference to the accompanying drawings and the embodiments. It should be understood that the embodiments of the disclosure and the specific features in the embodiments are a detailed description of the technical solutions of this application, rather than limiting the technical solutions of this application. The embodiments of this application and the technical features in the embodiments can be combined with one another in the case of no conflict.

**[0022]** Referring to FIG. 1, the disclosure provides an auxiliary switching device for a pivot-type suspended monorail multi-way turnout system, which is used to cooperate with conventional switching and driving structure to implement small-scale auxiliary adjustments of switching, improve accuracy and reliability, and reduce time consuming.

**[0023]** In some embodiments, the auxiliary switching device for the pivot-type suspended monorail multi-way turnout system includes: a first driving member 12, a bracket 21, a slide rail 13, a slide block 23, a second driving member 22 and a switching push head 24.

**[0024]** In some embodiments, the slide block 23 is fixed on the bracket 21, and the slide block 23 is slidably fixed onto the slide rail 13, so that the bracket 21 can move back and forth along an extension direction of the slide rail 13. An action end of the first driving member 12 is connected to the bracket 21 to provide power so as to drive the bracket 21 to move back and forth along a first axial direction. In some embodiments, the first driving member 12 may be fixed onto a pier transverse beam of a turnout beam through a fixing bracket 11. The slide rail 13 is provided on the pier transverse beam of the turnout beam. The bracket 21 can be driven by the first driving member 12 to move relative to the pier transverse beam.

**[0025]** The second driving member 22 is disposed on the bracket 21. The switching push head 24 is connected to an action end of the second driving member 22 and is driven by the second driving member 22 to move along a second axial direction, thereby pushing the turnout beam to move relative to the pier transverse beam to implement auxiliary switching operations, and therefore a positioning accuracy of the turnout beam, and timeliness and reliability of the switching operations are improved.

**[0026]** It is worth mentioning that positions of the second driving member 22 and even positions of the switching push head 24 can be flexibly adjusted through cooperations of the first driving member 12 with the slide rail 13, the slide block 23 and the bracket, and therefore it is convenient to accurately pushing against an effective position of the turnout beam. Therefore, it can adapt to installations under various specifications of working conditions.

**[0027]** In some embodiments, a pushing direction of

the second driving member 22 is consistent with a switching trend direction of the turnout beam, and pushing and pulling directions of the first driving member 12 are perpendicular to a pushing direction of the second driving member 22, thereby enabling coordinated operations in all directions, adjustments of a pushing-against position and auxiliary switching operations.

**[0028]** In some embodiments, the first driving member 12 may include a first electric cylinder 12a. An action end of the first electric cylinder 12a is connected to the bracket 21. In order to facilitate a fixation of the first electric cylinder 12a to the pier transverse beam, the first driving member 12 may also include a support of the first electric cylinder 12b as a support structure, and the support of the first electric cylinder 12b is disposed with a fixing structure for fixing onto the pier transverse beam of the turnout beam. A pushing-against surface and fasteners such as fastening bolts may be disposed on the support of the first electric cylinder 12b, to enable flexible disassembly and assembly. Correspondingly, a cylinder body fixing structure may be disposed on the support of the first electric cylinder 12b for fixing a cylinder body of the first electric cylinder 12a.

**[0029]** In order to ensure a stability of fixation for the bracket 21, the number of the slide rails 13 is more than two, and the two or more slide rails 13 are arranged in parallel, thereby ensuring the stability of fixation and a stability of posture during a sliding process, and suppressing a deflection amplitude, and ensuring positioning accuracy by forming a two-point support way.

**[0030]** In order to improve an adaptive performance of the switching push head 24, the switching push head 24 is pivotally connected to the action end of the second driving member 22, thereby ensuring that a contact surface of the switching push head 24 is always stably pushed against a surface of a pushed position of the turnout beam.

**[0031]** In some embodiments, the second driving member 22 may also include a second electric cylinder 22a. An action end of the second electric cylinder 22a is pivotally connected to the switching push head 24.

**[0032]** Referring to FIG. 2, FIG. 3, FIG. 4 and FIG. 5, the disclosure also relates to a pivot-type suspended monorail multi-way turnout system based on the above auxiliary switching device, which mainly includes: a turnout beam 40, a pier transverse beam 30 and the auxiliary switching device described in the above any embodiment.

**[0033]** The turnout beam 40 is movably connected to the pier transverse beam 30 and is usually placed on the pier transverse beam 30 through a travelling mechanism, so that the turnout beam 40 can move along the pier transverse beam 30 to implement the switching operations.

**[0034]** In order to cooperate with the auxiliary switching device, the turnout beam 40 is disposed with a contact portion to bear the switching push head 24. The first driving member 12 and the slide rail 13 are disposed on the pier transverse beam 30. Therefore, the second driving member 22 pushes against the contact portion to realize the auxiliary switching operations.

**[0035]** In order to meet requirements of the auxiliary switching operations, the number of the auxiliary switching devices is two. Pushing directions of switching of the two auxiliary switching devices are opposite to meet requirements of switching in two directions. In some embodiments, the number of auxiliary switching devices may be increased according to the number of multi-ways of turnouts, and there is no specific limit here.

**[0036]** Referring to FIG. 1, in some embodiments, in order to avoid a direct rigid collision, a buffer rubber pad 24a may be disposed on the switching push head 24. Similarly, the turnout beam 40 is disposed with a pushed pad 41 that matches with the switching push head 24.

**[0037]** With the pivot-type suspended monorail multi-way turnout system and auxiliary switching device in the disclosure, a first driving member and a slide rail that can be fixed to the pier transverse beam are disposed, so that a bracket that can be slidably fixed on the slide rail can be pushed and pulled as a load-bearing body of the second driving member for switching to adjust a position of the second driving member for switching, and therefore it is convenient to accurately pushing the turnout beam. The second driving member can use the bracket as the force-applying body, and use the bracket and the pier transverse beam connected thereto as a basis for applying force, and therefore the turnout beam can be pushed to move relative to the pier transverse beam, thereby realizing a movement of the turnout beam in a direction of switching. Therefore small-scale switching operations can be implemented to make up for inaccuracy and unreliable problems of conventional switching mechanisms, and in turn an efficiency of switching operations can be improved and a time consumption can be reduced.

**[0038]** In this application, unless otherwise clearly stated and limited, the terms "connection", "fixing" and so on should be understood in a broad sense. For example, the "fixing" may be a fixed connection, a detachable connection, or in an integral body; the "connection" may be a mechanical connection or an electrical connection, and may be a direct connection or an indirect connection through an intermediate medium, and may be an internal connection between two elements or an interactive relationship between two elements, unless otherwise clearly limited. For those skilled in the art, specific implication of the above terms in this application can be understood according to specific circumstances.

**[0039]** In the description of this application, it needs to be understood that the directions and positions or the positional relationships indicated by the terms "center", "longitudinal", "transverse", "length", "width", "thickness", "upper", "lower", "front", "back", "left", "right", "vertical", "horizontal", "top", "bottom", "inside", "outside", "clockwise", "counterclockwise" and so on are based on the orientations or positional relationships shown in the accompanying drawings, which are only for the con-

venience of describing this application and simplifying the description, and does not indicate or imply that the device or element referred to must have a specific orientation, be constructed and operated in a specific orientation, and therefore cannot be understood as a limitation on this application.

**[0040]** In addition, descriptions such as "first", "second" and so on in this application are for descriptive purposes only and cannot be understood as indicating or implying the relative importance or implicitly indicating the number of indicated technical features. Therefore, features defined as "first" and "second" may explicitly or implicitly include at least one of these features. In addition, the technical solutions in various embodiments can be combined with each other, but it must be based on the realization by those skilled in the art. When the combination of technical solutions is contradictory or cannot be realized, it should be considered that such a combination of technical solutions does not exist, nor is it within the protection scope sought by this application.

**[0041]** In the description of the present invention, unless otherwise expressly stated and limited, "above" or "below" a first feature to a second feature may include the first and second features being in direct contact, or may include the first and second features being not in direct contact but being in contact through another feature between them. Furthermore, a first feature is "over", "on a top of' and "above" a second feature includes the first feature being directly above and diagonally above the second feature, or simply indicates that the first feature is higher in level than the second feature. The first feature is "below", "under" and "beneath" the second feature includes the first feature being directly below and diagonally below the second feature, or simply indicates that the first feature is lower in level than the second feature.

**[0042]** In the description of this specification, the description with reference to the terms "one embodiment", "some embodiments", "an example", "specific examples" or "some examples" or the like indicates that specific features, structures, materials or characteristics described in connection with the embodiment or example are included in at least one embodiment or example of this application. In this specification, the schematic expressions of the above terms are not necessarily directed to the same embodiment or example. Furthermore, the specific features, structures, materials or characteristics described may be combined in any suitable manner in any one or more embodiments or examples. Furthermore, those skilled in the art may incorporate and combine the different embodiments or examples described in this specification.

**[0043]** Although preferred embodiments of this application have been described, those skilled in the art will be able to make additional changes and modifications to these embodiments once the basic inventive concepts are understood. Therefore, it is intended that the appended claims be construed to include the preferred embodiments and all changes and modifications that fall within the scope of this application.

**[0044]** Obviously, those skilled in the art can make various changes and modifications to this application without departing from the spirit and scope of this application. In this way, if these modifications and variations of this application fall within the scope of the claims of this application and equivalent technologies, this application is also intended to include these modifications and variations.

## Claims

1. An auxiliary switching device for a pivot-type suspended monorail multi-way turnout system, comprising: a first driving member, a bracket, a slide block, a slide rail, a second driving member and a switching push head;

   an action end of the first driving member is connected to the bracket to drive the bracket to move back and forth along a first axial direction;
   the slide block is disposed on the bracket, is slidably connected onto the slide rail, and moves along the first axial direction; and
   the second driving member is disposed on the bracket, and the switching push head is connected to an action end of the second driving member and is driven by the second driving member to move along a second axial direction.

2. The auxiliary switching device according to claim 1, wherein the first driving member comprises a first electric cylinder whose action end is connected to the bracket.

3. The auxiliary switching device according to claim 2, wherein the first driving member further comprises a support of the first electric cylinder;

   the support of the first electric cylinder is disposed with a fixing structure for fixing onto a pier transverse beam of a turnout beam; and
   a cylinder body of the first electric cylinder is disposed on the support of the first electric cylinder.

4. The auxiliary switching device according to claim 1, wherein the number of the slide rails is two or more, and two or more slide rails are arranged in parallel.

5. The auxiliary switching device according to claim 1, wherein the switching push head is pivotally connected to the action end of the second driving member.

6. The auxiliary switching device according to claim 5, wherein the second driving member comprises a second electric cylinder whose action end is pivotally connected to the switching push head.

7. A pivot-type suspended monorail multi-way turnout system, comprising: a turnout beam, a pier transverse beam, and the auxiliary switching device according to any one of claims 1 to 6;

the turnout beam is movably connected onto the pier transverse beam, and is disposed with a contact portion to bear the switching push head; and
the first driving member and the slide rail are disposed on the pier transverse beam.

8. The pivot-type suspended monorail multi-way turnout system according to claim 7, wherein the number of the auxiliary switching devices is two, and pushing directions of switching of two auxiliary switching devices are opposite.

9. The pivot-type suspended monorail multi-way turnout system according to claim 7, wherein the switching push head is disposed with a buffer rubber pad.

10. The pivot-type suspended monorail multi-way turnout system according to claim 9, wherein the turnout beam is disposed with a pushed pad that cooperates with the switching push head.

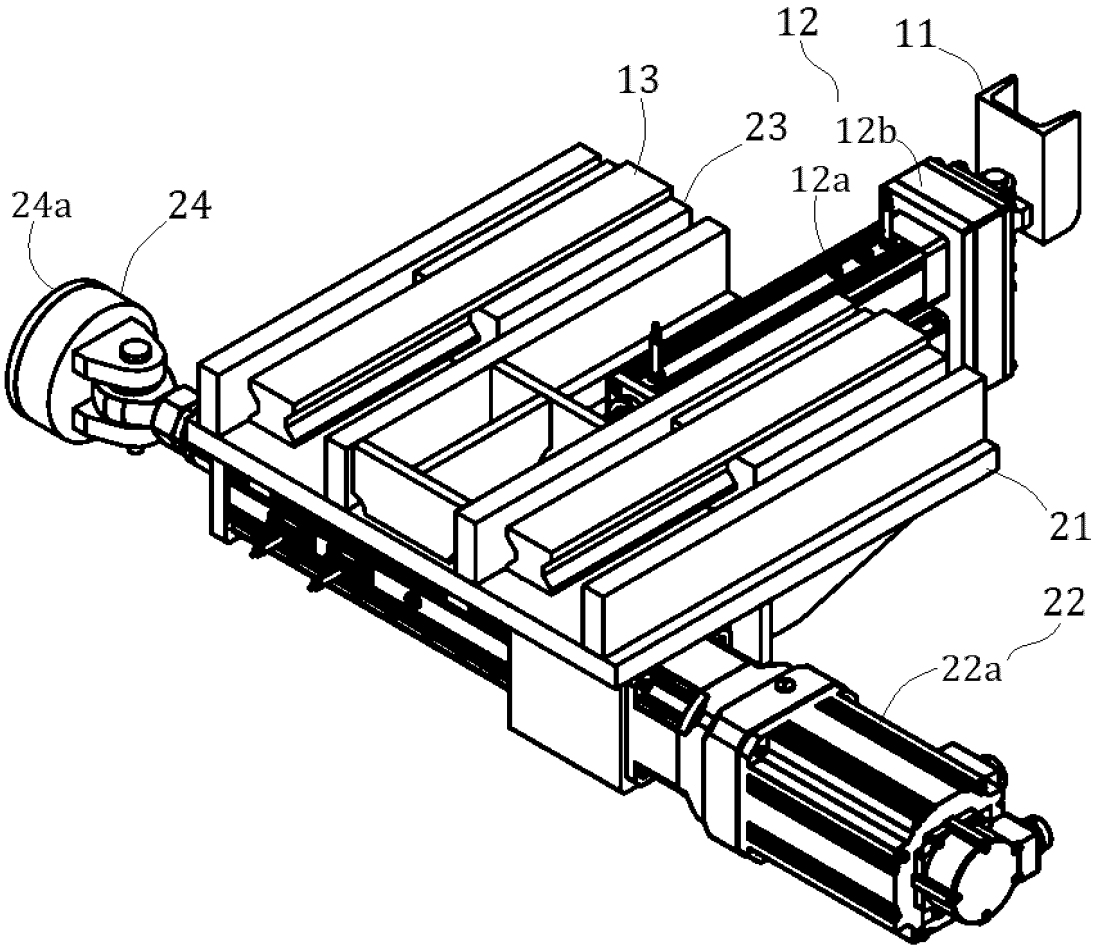


FIG. 1

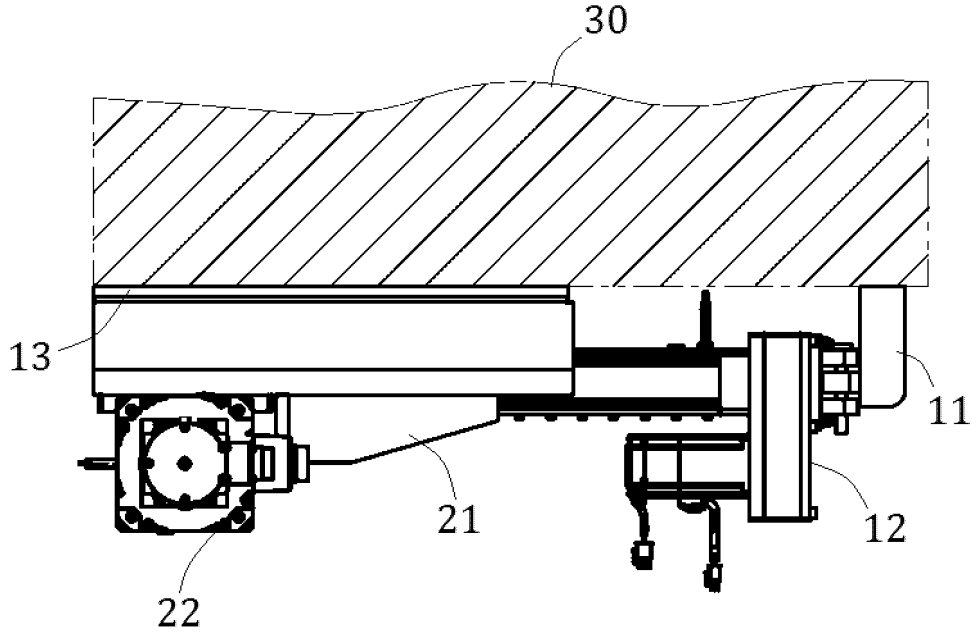


FIG. 2

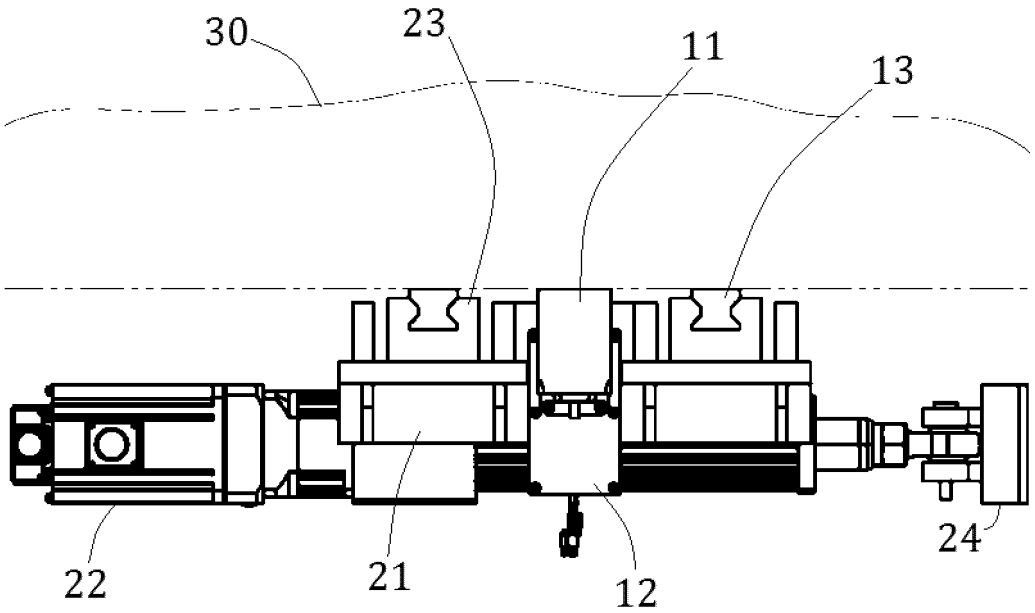


FIG. 3

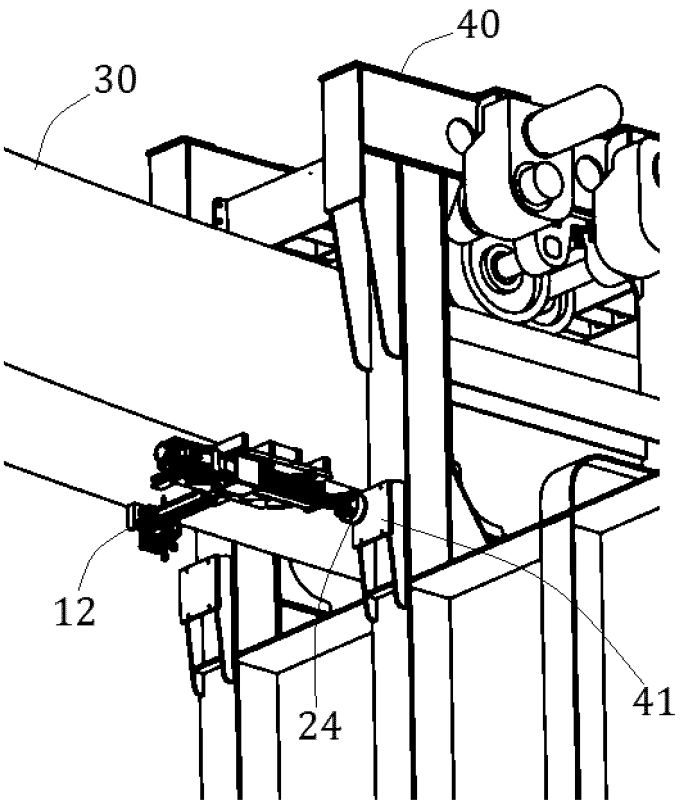


FIG. 4

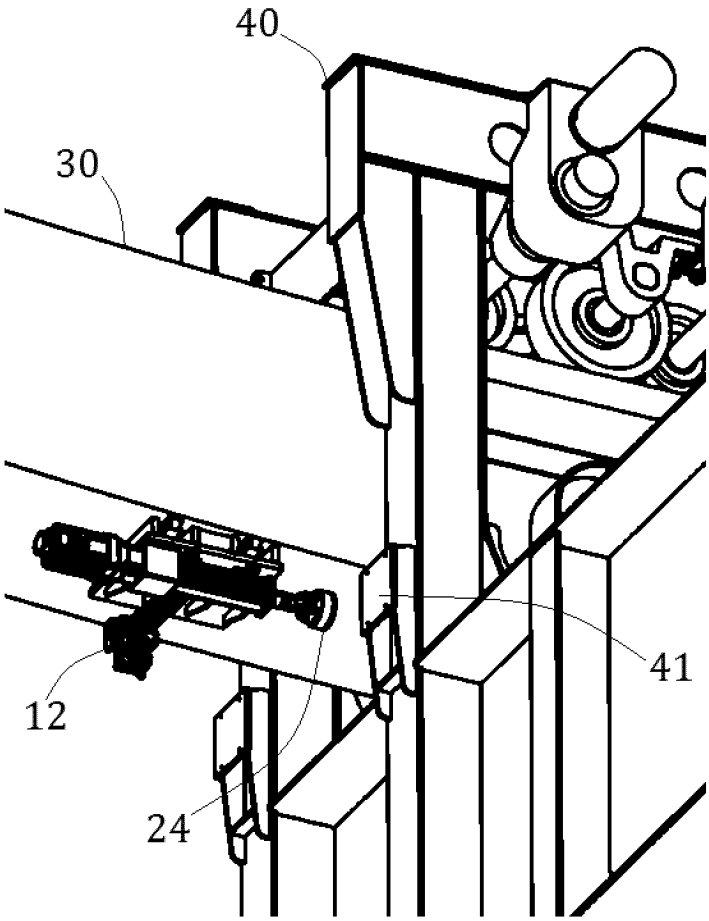


FIG. 5

**INTERNATIONAL SEARCH REPORT**

International application No.
**PCT/CN2023/073100**

**A. CLASSIFICATION OF SUBJECT MATTER**

B61L5/00(2006.01)i;E01B25/00(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)

B61L 5 , E01B 25

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, DWPI, ENTXT, CNKI: 单轨, 单轨多开道岔, 道岔, 辅助, 滑轨, 滑块, 精度, 驱动, 枢轴, 效率, 悬挂, 支架, 轴向, 转辙, 第一, 第二, rail, switch, driv+, axial direction, second, mov+

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| PX | CN 114475702 A (CRRC YANGTZE RIVER TRANSPORTATION EQUIPMENT GROUP CO., LTD.) 13 May 2022 (2022-05-13)<br>claims 1-10 | 1-10 |
| A | CN 113062152 A (CHINA RAILWAY CONSTRUCTION HEAVY INDUSTRY CORP., LTD.) 02 July 2021 (2021-07-02)<br>description, paragraphs [0002]-[0028], and figures 1-2 | 1-10 |
| A | CN 105040533 A (CHINA RAILWAY ENGINEERING DESIGN AND CONSULTING GROUP CO., LTD.) 11 November 2015 (2015-11-11)<br>entire document | 1-10 |
| A | CN 205012170 U (CHINA RAILWAY ENGINEERING DESIGN AND CONSULTING GROUP CO., LTD.) 03 February 2016 (2016-02-03)<br>entire document | 1-10 |
| A | JP S6471902 A (HITACHI LTD. et al.) 16 March 1989 (1989-03-16)<br>entire document | 1-10 |

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

* Special categories of cited documents:
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"P" document published prior to the international filing date but later than the priority date claimed
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"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 |
|---|---|
| **15 May 2023** | **15 May 2023** |
| Name and mailing address of the ISA/CN<br>**China National Intellectual Property Administration (ISA/CN)**<br>**China No. 6, Xitucheng Road, Jimenqiao, Haidian District, Beijing 100088** | Authorized officer<br><br>Telephone No. |

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

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

International application No.
**PCT/CN2023/073100**

| Patent document cited in search report | | | Publication date (day/month/year) | Patent family member(s) | Publication date (day/month/year) |
|---|---|---|---|---|---|
| CN | 114475702 | A | 13 May 2022 | None | |
| CN | 113062152 | A | 02 July 2021 | None | |
| CN | 105040533 | A | 11 November 2015 | None | |
| CN | 205012170 | U | 03 February 2016 | None | |
| JP | S6471902 | A | 16 March 1989 | None | |

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

## REFERENCES CITED IN THE DESCRIPTION

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### Patent documents cited in the description


- CN 202210082451 **[0001]**