Innovation, Sciences et Développement économique Canada
Office de la Propriété Intellectuelle du Canada

Innovation, Science and Economic Development Canada
Canadian Intellectual Property Office

CA 3149595 C 2024/05/28

(11)(21) 3 149 595

(12) BREVET CANADIEN
CANADIAN PATENT

(13) C

(86) Date de dépôt PCT/PCT Filing Date: 2020/09/17
(87) Date publication PCT/PCT Publication Date: 2021/03/25
(45) Date de délivrance/Issue Date: 2024/05/28
(85) Entrée phase nationale/National Entry: 2022/02/25
(86) N° demande PCT/PCT Application No.: CN 2020/115764
(87) N° publication PCT/PCT Publication No.: 2021/052393
(30) Priorité/Priority: 2019/09/17 (CN201921546485.9)

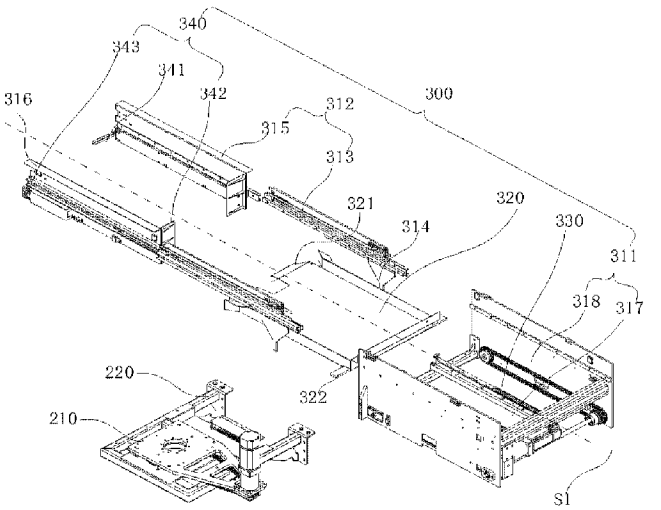
(51) Cl.Int./Int.Cl. *B66F 9/12* (2006.01), *B66F 9/06* (2006.01), *B66F 9/075* (2006.01), *B66F 9/19* (2006.01)

(72) Inventeur/Inventor:
ZHAN, QINGXIN, CN

(73) Propriétaire/Owner:
HAI ROBOTICS CO., LTD., CN

(74) Agent: BENNETT JONES LLP

(54) Titre : FOURCHE DE PALETTE ET ROBOT DE TRANSPORT
(54) Title: PALLET FORK AND CARRYING ROBOT



(57) Abrégé/Abstract:
Provided are a pallet fork and a carrying robot, wherein, the pallet fork (300) comprises a telescopic arrn and a temporary storage plate (320) and a sliding assernbly (330), the telescoping arm cornprises a fixed arrn (311), a rnovable arm (312), a push rod assembly (340) and a drive assembly, one end of the movable arm (312) is connected to the fixed arm (311), the other end is connected to the push rod assembly (340), the movable arm (312) can telescopically move relative to the fixed arm (311) under the action of the drive assembly, and the push rod assembly (340) is used for pulling goods or pushing goods; the temporary storage plate (320) is mounted on the fixed arm (311) and used for temporarily storing goods; the sliding assembly (330) is mounted between the fixed arm (311) and the temporary storage plate (320) and can push the ternporary stock plate (320) to stretch out relative to the fixed arm (311), and the extension direction of the temporary storage plate (320) is consistent with the extension direction of the movable arm (312). The sliding assembly of the pallet fork and the carrying robot can push the temporary storage plate (320) to stretch out relative to the fixed arm (311) so that containers can be stably transferred between a fixed shelf and the ternporary storage plate when the pallet fork pulls or pushes the goods.

Date Submitted: 2022/02/25

CA App. No.: 3149595

Abstract:

Provided are a pallet fork and a carrying robot, wherein, the pallet fork (300) comprises a telescopic arm and a temporary storage plate (320) and a sliding assembly (330), the telescoping arm comprises a fixed arm (311), a movable arm (312), a push rod assembly (340) and a drive assembly, one end of the movable arm (312) is connected to the fixed arm (311), the other end is connected to the push rod assembly (340), the movable arm (312) can telescopically move relative to the fixed arm (311) under the action of the drive assembly, and the push rod assembly (340) is used for pulling goods or pushing goods; the temporary storage plate (320) is mounted on the fixed arm (311) and used for temporarily storing goods; the sliding assembly (330) is mounted between the fixed arm (311) and the temporary storage plate (320) and can push the temporary stock plate (320) to stretch out relative to the fixed arm (311), and the extension direction of the temporary storage plate (320) is consistent with the extension direction of the movable arm (312). The sliding assembly of the pallet fork and the carrying robot can push the temporary storage plate (320) to stretch out relative to the fixed arm (311) so that containers can be stably transferred between a fixed shelf and the temporary storage plate when the pallet fork pulls or pushes the goods.

PALLET FORK AND CARRYING ROBOT

TECHNICAL FIELD

This application relates to the field of intelligent warehousing, and in particular, to a fork and a carrying robot.

BACKGROUND

Intelligent warehousing is a link in the logistics chain. The use of intelligent warehousing ensures the speed and accuracy of data input in all steps of warehouse management, so as to ensure that enterprises can grasp the real data of the inventory timely and accurately, and properly maintain and control the enterprise's inventory. Batches and shelf life of warehouse goods can be conveniently managed by means of scientific coding. By using the storage location management function of the SNHGES system, current locations of all warehouse goods can be grasped more timely, which is conducive to improving the efficiency of warehouse management.

The carrying robot plays an important role in the intelligent warehousing. The carrying robot replaces the manual carrying of goods, but when the existing carrying robot is carrying containers, the containers are unstable and easy to fall off.

SUMMARY

Based on this, it is necessary to provide a fork and a carrying robot to resolve the

WSLEGAL\070171\00028\34922523v1

Date Reçue/Date Received 2023-07-11

problem of instability of a container when being carried by the conventional carrying robot.

The fork provided in this application includes a telescopic arm, a temporary storage tray, and a sliding assembly. The telescopic arm includes a fixed arm, a movable arm, a pusher assembly, and a driving assembly. One end of the movable arm is connected to the fixed arm, and another end thereof is connected to the pusher assembly. The movable arm is extendable and retractable relative to the fixed arm with an action of the driving assembly. The pusher assembly is configured to pull in or push out goods during telescopic movement of the movable arm. The temporary storage tray is mounted to the fixed arm and is configured to temporarily store the goods pulled in by the pusher assembly. The sliding assembly is mounted between the fixed arm and the temporary storage tray and is capable of pushing the temporary storage tray to extend out relative to the fixed arm. An extending direction of the temporary storage tray is consistent with an extending direction of the movable arm.

In one embodiment, the sliding assembly includes a spring. One end of the spring is connected to the fixed arm, and another end thereof is connected to the temporary storage tray.

In one embodiment, the sliding assembly includes a spring, a guide rod, and a sliding block. The guide rod is fixed to the fixed arm, the spring and the sliding block are sleeved on the guide rod, the temporary storage tray is connected to the sliding block, and the temporary storage tray and the sliding block are slidable along the guide rod with an elastic action of the spring.

In one embodiment, a stopper is further disposed on the guide rod to prevent the temporary storage tray and the sliding block from slipping off the guide rod.

In one embodiment, a rib is disposed on the temporary storage tray, and a connecting plate is disposed on the movable arm. When the movable arm retracts relative to the fixed arm with the action of the driving assembly, the connecting plate abuts against the rib, so that the temporary storage tray is pushed to retract relative to the fixed arm.

In one embodiment, the movable arm includes a first arm section and a second

arm section. The first arm section is mounted to the fixed arm, and the second arm section is mounted to the first arm section. The driving assembly includes a first driving assembly and a second driving assembly. The first arm section is telescopically movable relative to the fixed arm with an action of the first driving assembly, and the second arm section is telescopically movable relative to the first arm section with an action of the second driving assembly.

In one embodiment, the first driving assembly is disposed on the fixed arm and includes a chain wheel mechanism and a driving member. An output end of the driving member is connected to a driving chain wheel of the chain wheel mechanism, a connecting plate is disposed on the first arm section, and the connecting plate is fixedly connected to a link chain of the chain wheel mechanism.

In one embodiment, the second driving assembly includes a movable pulley and a strop. The movable pulley is mounted to the first arm section, and a middle part of the strop is bent, so that two ends of the strop are disposed opposite to each other. The middle part of the strop is sleeved on the movable pulley, one end of the strop is fixedly connected to the fixed arm, and another end thereof is fixedly connected to the second arm section. The movable pulley and the strop form a movable pulley structure.

In one embodiment, the pusher assembly includes a movable pusher, a fixed pusher, and a pusher driving member. The movable pusher is mounted to a top end of the second arm section, and the fixed pusher is mounted to an end of the second arm section facing away from the movable pusher. The pusher driving member is connected to the movable pusher and is configured to drive the movable pusher to be folded or unfolded relative to the second arm section. The movable pusher is configured to pull the goods to the temporary storage tray during retraction of the movable arm, and the fixed pusher is configured to push out the goods on the temporary storage tray during the extension of the movable arm.

This application further provides a carrying robot, including a robot body and a handling device. The handling device includes a rotary assembly, a fork bracket, and any of the forks described above. The fork bracket is mounted to the robot body, and

the fork and the rotary assembly are both mounted to the fork bracket. The fork is rotatable relative to the fork bracket in a vertical direction with an action of the rotary assembly.

In one embodiment, the robot body includes a movable chassis, a shelving unit, and a lifting assembly. The shelving unit is mounted to the movable chassis, the shelving unit includes more than two shelf board assemblies distributed at different heights, and each shelf board assembly includes a shelf board for placing goods. The lifting assembly is configured to drive the handling device to rise and fall relative to the shelving unit, so that the fork is at a same height as one of the shelf boards.

According to the fork and the carrying robot provided in this application, the sliding assembly is disposed between the fixed arm of the handling device and the temporary storage tray. The sliding assembly is capable of pushing the temporary storage tray to extend out relative to the fixed arm, and the extending direction of the temporary storage tray is consistent with the extending direction of the movable arm. Therefore, when the fork of this application pulls in or pushes out the goods, the container can be stably carried between the stationary shelving unit and the temporary storage tray and will not fall off during the carrying.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic structural diagram of a carrying robot in an initial state according to an embodiment of this application.

FIG. 2 is a schematic diagram of an exploded structure of a handling device according to an embodiment of this application.

FIG. 3 is a schematic structural diagram of a movable arm of a handling device in an extended state according to an embodiment of this application.

FIG. 4 is a schematic structural diagram of a movable arm of a handling device in a retracted state according to an embodiment of this application.

FIG. 5 is a schematic structural diagram of a first arm section according to an embodiment of this application.

FIG. 6 is a schematic diagram of a handling device when facing to a stationary shelving unit according to an embodiment of this application.

FIG. 7 is a schematic structural diagram of a handling device when pulling goods according to an embodiment of this application.

FIG. 8 is a schematic structural diagram during retraction of a movable arm after a handling device pulls goods according to an embodiment of this application.

FIG. 9 is a schematic structural diagram of a handling device when facing to a shelving unit according to an embodiment of this application.

FIG. 10 is a schematic structural diagram during pushing of goods on a temporary storage tray to a shelving unit by a handling device according to an embodiment of this application.

Reference numerals:

Robot body 100, Movable chassis 110, Shelving unit 120, Shelf board 121; Handling device 200, Rotary assembly 210, Fork bracket 220, Symmetry axis S1, Fork 300, Fixed arm 311, Underframe 317, Side wall 318, Movable arm 312, First arm section 313, Connecting plate 314, Second arm section 315, Top end 316, Temporary storage tray 320, Free end 321, Rib 322, Sliding assembly 330, Spring 331, Guide rod 332, Sliding block 333, Stopper 334, Pusher assembly 340, Movable pusher 341, Fixed pusher 342, Pusher driving member 343, First driving assembly 350, Chain wheel mechanism 351, Driving member 352, Second driving assembly 360, Movable pulley 361, Strop 362; and Stationary shelving unit 400.

DETAILED DESCRIPTION

For ease of understanding this application, this application is described more comprehensively below with reference to the accompanying drawings. Exemplary embodiments of this application are provided in the accompanying drawings. However, this application may be implemented in many different forms, and is not limited to the embodiments described in this specification. On the contrary, an objective of providing the embodiments is to make the understanding of the disclosure

content of this application more clearly and comprehensively.

It should be noted that, when a component is referred to as "being fixed to" another component, the component may be directly on the another component, or there may be an intermediate component between them. When a component is considered to be "connected to" another component, the component may be directly connected to the another component, or there may be an intermediate component between them. The terms "vertical", "horizontal", "left", "right" and similar expressions used in this specification are merely for purposes of illustration but not indicate a unique way for implementation.

Unless otherwise defined, meanings of all technical and scientific terms used in this specification are the same as those usually understood by a person skilled in the art to which this application belongs. In this application, terms used herein are merely intended to describe the specific embodiments, but are not intended to limit this application. The term "and/or" used in this specification includes any and all combinations of one or more related listed items.

FIG. 1 is a schematic structural diagram of a carrying robot in an initial state according to an embodiment of this application. As shown in FIG. 1, in one embodiment, the carrying robot includes a robot body 100 and a handling device 200. The robot body 100 includes a movable chassis 110, a shelving unit 120, and a lifting assembly (not shown in the figure). The shelving unit 120 is mounted to the movable chassis 110, the shelving unit 120 includes more than two shelf board assemblies distributed at different heights, and each shelf board assembly includes a shelf board 121 for placing goods. The lifting assembly is configured to drive the handling device 200 to rise and fall relative to the shelving unit 120, so that the handling device 200 is at the same height as the shelf board 121 or a stationary shelving unit 400. FIG. 2 is a schematic diagram of an exploded structure of a handling device according to an embodiment of this application. As shown in FIG. 2, the handling device 200 includes a rotary assembly 210, a fork bracket 220, and a fork 300. The fork bracket 220 is mounted to the shelving unit 120 and can be lifted or lowered relative to the shelving unit 120 with an action of a lifting assembly. The fork 300 and the rotary assembly

210 are both mounted to the fork bracket 220. The fork 300 is rotatable relative to the fork bracket 220 in a vertical direction with an action of the rotary assembly 210. The fork 300 is used for carrying goods to the shelf board 121 at the same height as the fork 300 or used for moving out the goods from the shelf board 121 at the same height as the fork 300.

FIG. 3 is a schematic structural diagram of a movable arm of a handling device in an extended state according to an embodiment of this application. As shown in FIG. 2 and FIG. 3, the fork 300 has a symmetry axis S1 and includes a telescopic arm, a temporary storage tray 320, and a sliding assembly 330. The telescopic arm includes a fixed arm 311, a movable arm 312, a pusher assembly 340, and a driving assembly. The fixed arm 311 includes an underframe 317 and two side walls 318 that are fixedly connected to the underframe 317. The underframe 317 is mounted to the rotary assembly 210. One end of the movable arm 312 is connected to the side wall 318 of the fixed arm 311, and another end thereof is connected to the pusher assembly 340. The movable arm 312 is telescopically movable relative to the fixed arm 311 along the symmetry axis S1 with an action of the driving assembly. The pusher assembly 340 is configured to pull in or push out goods during the telescopic movement of the movable arm 312, and the temporary storage tray 320 is mounted to the underframe 317 of the fixed arm 311 and is used for temporarily storing the goods pulled by the pusher assembly 340. The sliding assembly 330 is mounted between the underframe 317 of the fixed arm 311 and the temporary storage tray 320, and is capable of pushing the temporary storage tray 320 to extend out relative to the fixed arm 311 along the symmetry axis S1. An extending direction of the temporary storage tray 320 is consistent with an extending direction of the movable arm 312.

Further, in one embodiment, as shown in FIG. 2 and FIG. 3, quantities of the side walls 318 of the fixed arm 311 and the movable arms 312 are both two. The two side walls 318 and the two movable arms 312 are symmetrically disposed on two opposite sides of the symmetry axis S1. Each movable arm 312 includes a first arm section 313 and a second arm section 315. The first arm section 313 is mounted to the fixed arm 311, and the second arm section 315 is mounted to the first arm section 313. FIG. 5 is

CA 03149595 2022-2-25
WSLEGAL\070171\00028\29811097v1

a schematic structural diagram of a first arm section according to an embodiment of this application, and FIG. 6 is a schematic structural diagram of a handling device when facing to a stationary shelving unit according to an embodiment of this application. As shown in FIG. 5 and FIG. 6, the driving assembly includes a first driving assembly 350 and a second driving assembly 360. The first arm section 313 is telescopically movable relative to the fixed arm 311 with an action of the first driving assembly 350, and the second arm section 315 is telescopically movable relative to the first arm section 313 with an action of the second driving assembly 360. In a specific embodiment, as shown in FIG. 3, the fixed arm 311 is an outer arm, the first arm section 313 is a middle arm, and the second arm section 315 is an inner arm. The middle arm is mounted to an inner side of a side wall of the outer arm, and the inner arm is mounted to an inner side of the middle arm. The middle arm is telescopically movable relative to the outer arm with the action of the first driving assembly 350, and the inner arm is telescopically movable relative to the middle arm with the action of the second driving assembly 360. It may be understood that, in another specific embodiment, the fixed arm 311 may further be an inner arm, the first arm section 313 is a middle arm, and the second arm section 315 is an outer arm. The middle arm is mounted to an outer side of a side wall of the inner arm, and the outer arm is mounted to an outer side of the middle arm. In addition, according to an actual condition, the number of movable arms 312 is not limited to two, and in other embodiments, the number of movable arms 312 may be one. In addition, it may be understood that, in another embodiment, the movable arm 312 may include only the inner arm, but not the middle arm. The inner arm is mounted to the inner side of the side wall of the outer arm, and the inner arm is telescopically movable relative to the outer arm along the symmetry axis S1 with the action of the driving assembly. In still another embodiment, the movable arm 312 may include an inner arm and more than two middle arms. The movable arm 312 is telescopically movable relative to the outer arm along the symmetry axis S1 with the action of the driving assembly.

In one embodiment, as shown in FIG. 2, the sliding assembly 330 includes a spring 331. One end of the spring 331 is connected to the underframe 317 of the fixed

CA 03149595 2022-2-25
WSLEGAL\070171\00028\29811097v1

arm 311, and another end thereof is connected to the temporary storage tray 320. The temporary storage tray 320 extends out relative to the fixed arm 311 with the push of an elastic force of the spring 331. FIG. 7 is a schematic structural diagram of a handling device when pulling goods according to an embodiment of this application. As shown in FIG. 7, when the temporary storage tray 320 extends out relative to the fixed arm 311, a free end 321 of the temporary storage tray 320 may protrude from the fixed arm 311. FIG. 4 is a schematic structural diagram of a movable arm of a handling device in a retracted state according to an embodiment of this application. In another embodiment, as shown in FIG. 3 and FIG. 4, the sliding assembly 330 includes a spring 331, a guide rod 332, and a sliding block 333. The guide rod 332 is fixed to the fixed arm 311, and the spring 331 and the sliding block 333 are both sleeved on the guide rod 332. The temporary storage tray 320 is connected to the sliding block 333, and the temporary storage tray 320 and the sliding block 333 are slidable along the guide rod 332 with the elastic action of the spring 331. Further, a stopper 334 is further disposed on the guide rod 332 to prevent the temporary storage tray 320 and the sliding block 333 from slipping off the guide rod 332.

It should be noted that this application does not limit the number of guide rods 332, sliding blocks 333, and springs 331 in the sliding assembly 330. In the embodiment shown in FIG. 3 and FIG. 4, two guide rods 332 are disposed, four sliding blocks 333 are disposed, and two springs 331 are disposed. It may be understood that, in other embodiments, one guide rod or other number of guide rods 332 may be disposed, one sliding block or other number of sliding blocks 333 may be disposed, and one spring or other number of springs 331 may be disposed.

In one embodiment, as shown in FIG. 2, the pusher assembly 340 is mounted to the second arm section 315. The pusher assembly 340 includes a fixed pusher 342, a movable pusher 341, and a pusher driving member 343. The movable pusher 341 is mounted to a top end 316 of the second arm section 315. It may be understood that the top end 316 mentioned herein refers to an end farthest from the fixed arm 311 when the movable arm 312 extends out relative to the fixed arm 311 along the symmetry axis S1. The fixed pusher 342 is mounted to an end of the second arm section 315

CA 03149595 2022-2-25
WSLEGAL\070171\00028\29811097v1

facing away from the movable pusher 341, and the pusher driving member 343 is connected to the movable pusher 341 for driving the movable pusher 341 to be folded or unfolded relative to the second arm section 315. When the movable pusher 341 is unfolded relative to the second arm section 315, the movable pusher 341 protrudes from the second arm section 315 in a direction close to the symmetry axis S1, as shown in FIG. 2. When the movable pusher 341 is folded relative to the second arm section 315, the movable pusher 341 and the second arm section 315 substantially overlap, as shown in FIG. 3. In a specific embodiment, the pusher driving member 343 is a pusher motor. The movable pusher 341 is directly driven by the pusher motor. The pusher motor is configured to drive the movable pusher 341 to rotate relative to the second arm section 315, so that the movable pusher 341 is unfolded or folded relative to the second arm section 315. It may be understood that, according to the actual condition, in other embodiments, the movement manner of the movable pusher 341 is not limited to rotation. For example, the movable pusher 341 may extend out of the second arm section 315 or retract into the second arm section 315.

In one embodiment, as shown in FIG. 3 and FIG. 4, the first driving assembly 350 is disposed on the fixed arm 311 and includes a chain wheel mechanism 351 and a driving member 352. An output end of the driving member 352 is connected to a driving chain wheel of the chain wheel mechanism 351. A connecting plate 314 is disposed on the first arm section 313, and the connecting plate 314 is fixedly connected to a link ring of the chain wheel mechanism 351. The first driving assembly 350 is configured to drive the driving chain wheel to rotate. Since the first arm section 313 is fixedly connected to the link ring of the chain wheel mechanism 351 by using the connecting plate 314, the chain wheel mechanism 351 can drive, by using the connecting plate 314, the first arm section 313 to move relative to the fixed arm 311 along the symmetry axis S1. As shown in FIG. 2, a rib 322 is disposed on the temporary storage tray 320. FIG. 8 is a schematic structural diagram of a movable arm when retracting after a handling device pulls goods according to an embodiment of this application. As shown in FIG. 8, when the first arm section 313 retracts relative to the fixed arm 311 with the action of the first driving assembly 350, the connecting

CA 03149595 2022-2-25
WSLEGAL\070171\00028\29811097v1

plate 314 abuts against the rib 322. Therefore, the temporary storage tray 320 can be pushed to retract relative to the fixed arm 311, and the temporary storage tray 320 is pushed back to the original position. When the temporary storage tray 320 is pushed back to the original position, as shown in FIG. 4, the spring 331 is in a compressed state, and the connecting plate 314 blocks the temporary storage tray 320 to be located on the underframe 317 of the fixed arm 311. Once the connecting plate 314 extends out relative to the fixed arm 311 along with the first arm section 313 with the action of the first driving assembly 350, as shown in FIG. 7, the temporary storage tray 320 loses obstruction and is pushed out with an elastic restoring force of the spring 331, so that the free end 321 of the temporary storage tray 320 protrudes from the fixed arm 311. It should be noted that a direction in which the temporary storage tray 320 is pushed out by the spring 331 is consistent with a direction in which the movable arm 312 extends out relative to the fixed arm 311. It may be understood that, according to the actual condition, the chain wheel mechanism 351 of the first driving assembly 350 may be replaced with a pulley mechanism or the like.

In addition, it should be noted that in the embodiment shown in FIG. 4, the spring 331 is a compression spring. It may be understood that in other embodiments, the spring 331 may further be a tension spring. When the temporary storage tray 320 is pushed back to the original position, the spring 331 is in a stretched state, and the connecting plate 314 blocks the temporary storage tray 320 to be located on the underframe 317 of the fixed arm 311. Once the connecting plate 314 extends out relative to the fixed arm 311 along with the first arm section 313 with the action of the first driving assembly 350, the temporary storage tray 320 loses obstruction and is pushed out with the elastic restoring force of the spring 331.

In one embodiment, as shown in FIG. 5, the second driving assembly 360 includes a movable pulley 361 and a strop 362. The movable pulley 361 is mounted to the first arm section 313, and a middle part of the strop 362 is bent, so that two ends of the strop 362 are disposed opposite to each other. The middle part of the strop 362 is sleeved on the movable pulley 361, one end of the strop 362 is fixedly connected to the fixed arm 311, and another end thereof is fixedly connected to the second arm

section 315. The movable pulley 361 and the strop 362 form a movable pulley structure. When the first arm section 313 moves at a first speed relative to the fixed arm 311, the second arm section 315 moves at a second speed relative to the fixed arm 311. The second speed is twice the first speed. By disposing a movable pulley mechanism, the extension or retraction speed of the second arm section 315 can be faster, and the efficiency of picking and placing goods of the fork is improved. In a specific embodiment, the movable pulley 361 is a flat pulley, and the strop 362 is an open-loop flat belt. It may be understood that, in other embodiments, the movable pulley 361 may be a chain wheel, and the strop 362 may be a link chain.

When the handling device 200 is in an initial state, as shown in FIG. 1, the free end 321 of the temporary storage tray 320 faces the shelving unit 120. The carrying robot carries the container on the stationary shelving unit 400 to the shelf board 121 of the shelving unit 120 by performing the following steps. Step 1: The handling device 200 is lifted or lowered relative to the shelving unit 120 with an action of the lifting assembly, so that the symmetry axis S1 of the fork 300 is at a same height as the container on the stationary shelving unit 400. Step 2: As shown in FIG. 6, the fork 300 rotates with an action of the rotary assembly 210, so that the container is located on the symmetry axis S1 of the fork 300, and the free end 321 of the temporary storage tray 320 faces the container on the stationary shelving unit 400. It should be noted that, in the embodiments shown in FIG. 1 and FIG. 6, the container on the stationary shelving unit 400 is not shown in the figures. Step 3: As shown in FIG. 7, the movable arm 312 extends out relative to the fixed arm 311 along the symmetry axis S1 with the action of the driving assembly. At the same time, the temporary storage tray 320 loses the blocking of the connecting plate 314 and is then pushed out with the action of the elastic restoring force of the spring 331, so that the free end 321 of the temporary storage tray 320 protrudes from the fixed arm 311, and the free end 321 of the temporary storage tray 320 is closer to the stationary shelving unit 400. In addition, in step 3, the movable pusher 341 mounted to the top end 316 of the second arm section 315 is folded relative to the second arm section 315, and the top end 316 of the second arm section 315 moves from a side of the container facing the

CA 03149595 2022-2-25
WSLEGAL\070171\00028\29811097v1

temporary storage tray 320 to a side of the container facing away from the temporary storage tray 320. Step 4: The movable pusher 341 is unfolded relative to the second arm section 315 with an action of the pusher driving member 343, and then the movable arm 312 retracts relative to the fixed arm 311 along the symmetry axis S1 with the action of the driving assembly, so that the movable pusher 341 can pull the container onto the temporary storage tray 320. As shown in FIG. 8, when the movable arm 312 retracts to a certain extent, the connecting plate 314 on the first arm section 313 abuts against the rib 322 on the temporary storage tray 320, and the second arm section 315 continues to retract relative to the fixed arm 311 along the symmetry axis S1 with the action of the driving assembly, and pushes the temporary storage tray 320 to retract relative to the fixed arm 311 along the symmetry axis S1, thereby pushing the temporary storage tray 320 back to the original position.

Step 5: FIG. 9 is a schematic structural diagram of a handling device when facing to a shelving unit according to an embodiment of this application. As shown in FIG. 9, the fork 300 rotates with an action of the rotary assembly 210, so that the free end 321 of the temporary storage tray 320 faces the shelf board 121 on the shelving unit 120. Step 6: The handling device 200 is lifted or lowered relative to the shelving unit 120 with the action of the lifting assembly, so that the symmetry axis S1 of the fork 300 is at the same height as one empty shelf board 121 on the shelving unit 120. Step 7: FIG. 10 is a schematic structural diagram of a handling device when pushing goods on a temporary storage tray to a shelving unit according to an embodiment of this application. As shown in FIG. 10, the movable arm 312 extends out relative to the fixed arm 311 along the symmetry axis S1 with an action of the driving assembly. At the same time, the temporary storage tray 320 loses the blocking of the first arm section 313 and is then pushed out by the elastic restoring force of the spring 331, so that the free end 321 of the temporary storage tray 320 protrudes from the fixed arm 311, and the temporary storage tray 320 is closer to the shelf board 121 on the shelving unit 120. During the extending of the movable arm 312, the container is pushed onto the empty shelf board 121 of the shelving unit 120 by the fixed pusher 342. In addition, in step 7, the movable pusher 341 mounted to the top end 316 of the

second arm section 315 may be folded relative to the second arm section 315 or may be unfolded relative to the second arm section 315. In this embodiment, the movable pusher 341 is unfolded relative to the second arm section 315, and the unfolded movable pusher 341 can prevent the container from falling from another end of the shelf board 121. Step 8: The movable pusher 341 is folded relative to the second arm section 315 with the action of the pusher driving member 343 (in another embodiment, this step may also be performed in step 5, step 6, or step 7. If the movable pusher 341 has been folded relative to the second arm section 315 in step 7, then this step can be omitted in step 8). The movable arm 312 retracts relative to the fixed arm 311 along the symmetry axis S1 with the action of the driving assembly. When the movable arm 312 retracts to a certain extent, the connecting plate 314 on the first arm section 313 abuts against the rib 322 on the temporary storage tray 320, and the movable arm 312 continues to retract relative to the fixed arm 311 along the symmetry axis S1 with the action of the driving assembly, and pushes the temporary storage tray 320 to retract relative to the fixed arm 311 along the symmetry axis S1, thereby pushing the temporary storage tray 320 back to the original position.

It may be understood that the carrying robot of this application may further carry the container on the shelf board 121 of the shelving unit 120 to the stationary shelving unit 400. This process is contrary to the above process, and the details will not be described herein again.

According to the fork and the carrying robot of this application, the sliding assembly is disposed between the fixed arm of the handling device and the temporary storage tray. The sliding assembly is capable of pushing the temporary storage tray to extend out relative to the fixed arm, and the extending direction of the temporary storage tray is consistent with the extending direction of the movable arm. Therefore, when the fork of this application pulls in or pushes out the goods, the container can be stably carried between the stationary shelving unit and the temporary storage tray and will not fall off during the carrying.

The technical features in the foregoing embodiments may be randomly combined. For concise description, not all possible combinations of the technical features in the

embodiments are described. However, provided that combinations of the technical features do not conflict with each other, the combinations of the technical features are considered as falling within the scope described in this specification.

The foregoing embodiments show only several implementations of this application and are described in detail, which, however, are not to be construed as a limitation to the patent scope of the present utility model. A person of ordinary skill in the art may further make several variations and improvements without departing from the ideas of this application, and such variations and improvements all fall within the protection scope of this application. Therefore, the protection scope of the patent of this application shall be subject to the appended claims.

CLAIMS

1. A fork, comprising:

a telescopic arm, comprising a fixed arm, a movable arm, a pusher assembly, and a driving assembly, wherein one end of the movable arm is connected to the fixed arm, another end thereof is connected to the pusher assembly, the movable arm is telescopically movable relative to the fixed arm with an action of the driving assembly, and the pusher assembly is configured to pull in or push out goods during a telescopic movement of the movable arm;

a temporary storage tray, mounted to the fixed arm and configured to temporarily store the goods pulled by the pusher assembly; and

a sliding assembly, mounted between the fixed arm and the temporary storage tray and capable of pushing the temporary storage tray to extend out relative to the fixed arm, wherein an extending direction of the temporary storage tray is consistent with an extending direction of the movable arm; wherein the sliding assembly comprises a spring, one end of the spring is connected to the fixed arm, and another end thereof is connected to the temporary storage tray.

2. The fork according to claim 1, wherein the sliding assembly further comprises a guide rod and a sliding block, the guide rod is fixed to the fixed arm, the spring and the sliding block are sleeved on the guide rod, the temporary storage tray is connected to the sliding block, and the temporary storage tray and the sliding block are slidable along the guide rod with an elastic action of the spring.

3. The fork according to claim 2, wherein a stopper is further disposed on the guide rod to prevent the temporary storage tray and the sliding block from slipping off the guide rod.

4. The fork according to claim 2, wherein a rib is disposed on the temporary storage tray, a connecting plate is disposed on the movable arm, and when the movable arm retracts relative to the fixed arm with the action of the driving assembly, the connecting plate abuts against the rib, so that the temporary storage tray is pushed to retract relative to the fixed arm.

WSLEGAL\070171\00028\34922875v1

Date Reçue/Date Received 2023-07-11

5. The fork according to any of claims 1 to 4, wherein the movable arm comprises a first arm section and a second arm section, the first arm section is mounted to the fixed arm, the second arm section is mounted to the first arm section, the driving assembly comprises a first driving assembly and a second driving assembly, the first arm section is telescopically movable relative to the fixed arm with an action of the first driving assembly, and the second arm section is telescopically movable relative to the first arm section with an action of the second driving assembly.

6. The fork according to claim 5, wherein the first driving assembly is disposed on the fixed arm and comprises a chain wheel mechanism and a driving member, an output end of the driving member is connected to a driving chain wheel of the chain wheel mechanism, a connecting plate is disposed on the first arm section, and the connecting plate is fixedly connected to a link chain of the chain wheel mechanism.

7. The fork according to claim 5, wherein the second driving assembly comprises a movable pulley and a strop, the movable pulley is disposed on the first arm section, a middle part of the strop is bent, so that two ends of the strop are disposed opposite to each other, the middle part of the strop is sleeved on the movable pulley, one end of the strop is fixedly connected to the fixed arm, another end thereof is fixedly connected to the second arm section, and the movable pulley and the strop form a movable pulley structure.

8. The fork according to claim 5, wherein the pusher assembly comprises a movable pusher, a fixed pusher, and a pusher driving member, the movable pusher is mounted to a distal end of the second arm section, the fixed pusher is mounted to an end of the second arm section facing away from the movable pusher, the pusher driving member is connected to the movable pusher and is configured to drive the movable pusher to be folded or unfolded relative to the second arm section, the movable pusher is configured to pull the goods to the temporary storage tray during retraction of the movable arm, and the fixed pusher is configured to push out the goods on the temporary storage tray during the extension of the movable arm.

9. A carrying robot, comprising a robot body and a handling device, wherein the handling device comprises a rotary assembly, a fork bracket, and the fork according to

Date Reçue/Date Received 2023-07-11

any of claims 1 to 8, the fork bracket is mounted to the robot body, the fork and the rotary assembly are both mounted to the fork bracket, and the fork is rotatable relative to the fork bracket around a vertical axis with an action of the rotary assembly.

10. The carrying robot according to claim 9, wherein the robot body comprises a movable chassis, a shelving unit, and a lifting assembly, the shelving unit is mounted to the movable chassis, the shelving unit comprises more than two shelf board assemblies distributed at different heights, each shelf board assembly comprises a shelf board for placing goods, and the lifting assembly is configured to drive the handling device to rise and fall relative to the shelving unit, so that the fork is at a same height as one of the shelf boards.

Date Reçue/Date Received 2023-07-11

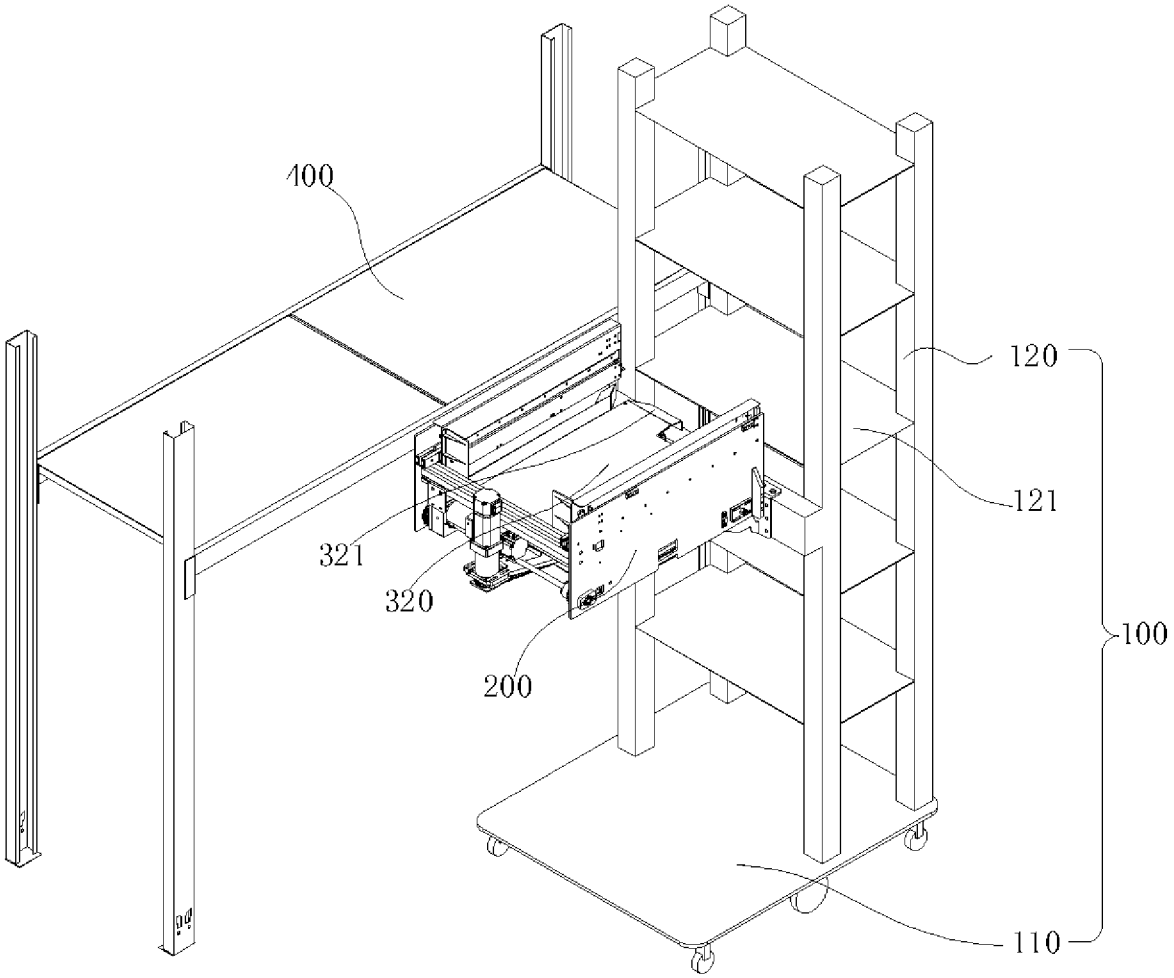


FIG. 1

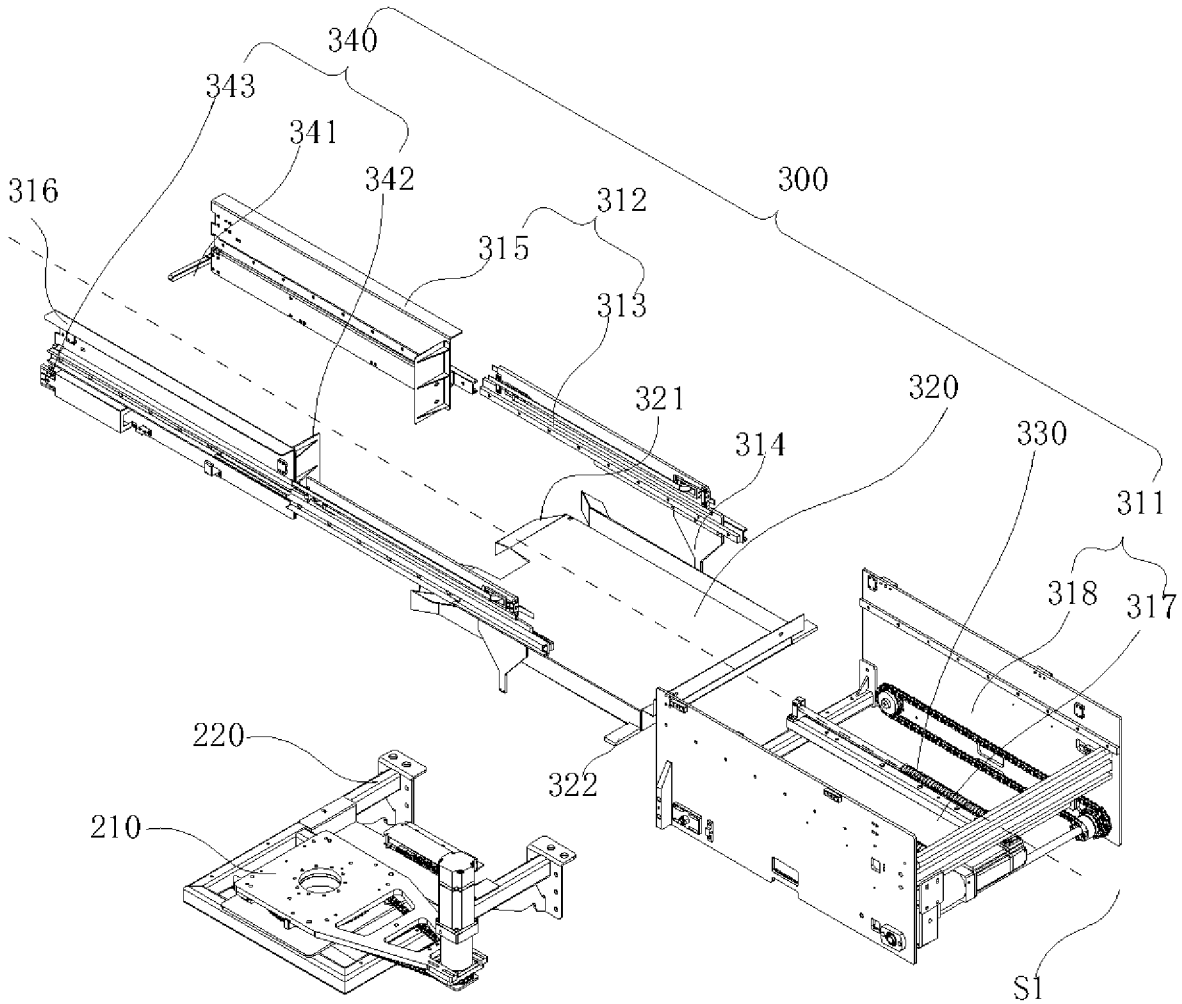

340
343
341
342
316
300
312
315
313
321
320
330
314
311
318
317
220
322
210
S1

FIG. 2

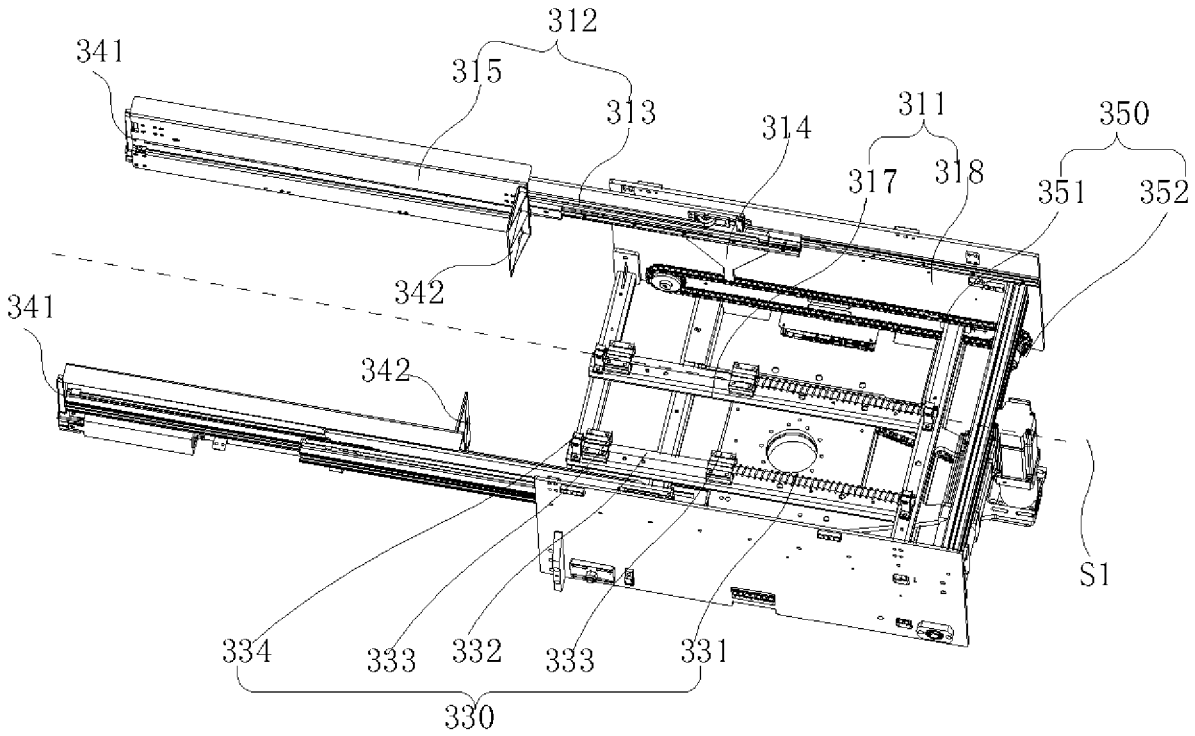

312
341
315
313
314
311
350
317
318
351
352
342
341
342
S1
334
333
332
333
331
330

FIG. 3

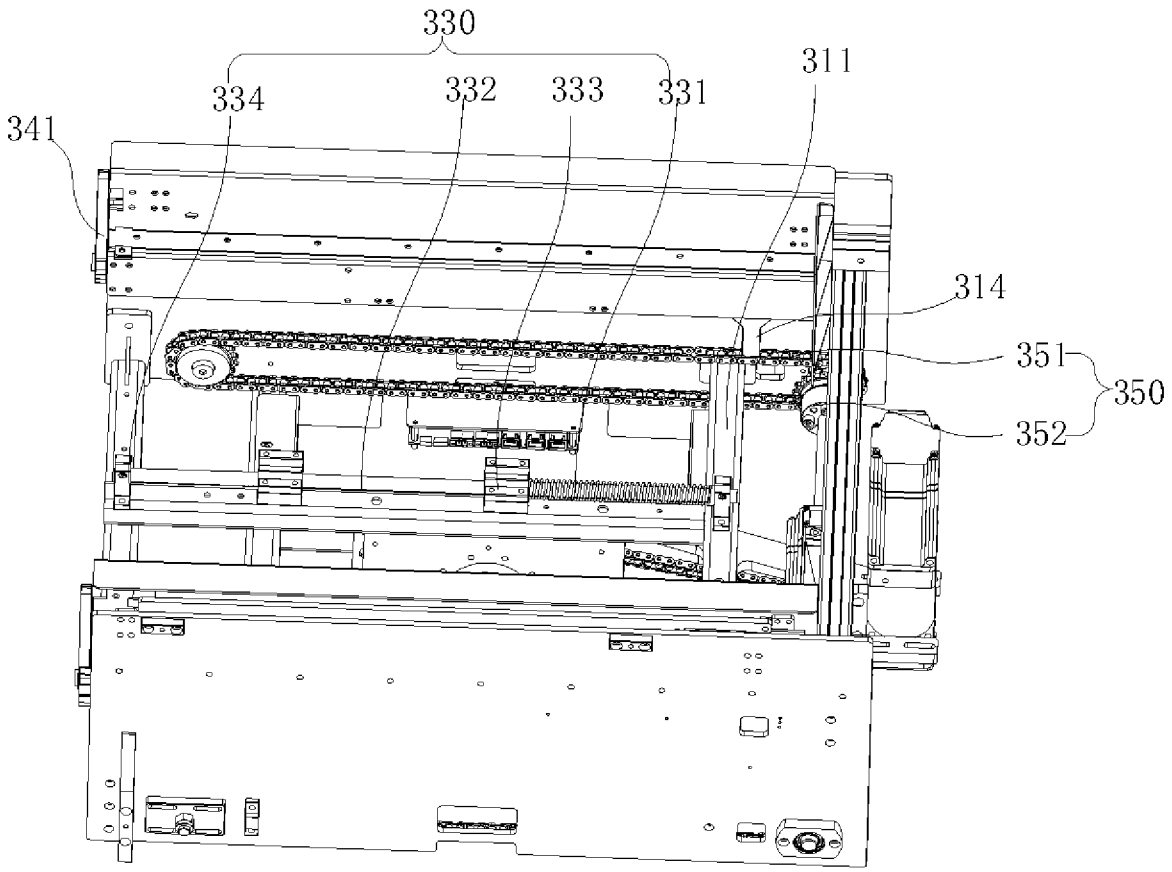


FIG. 4

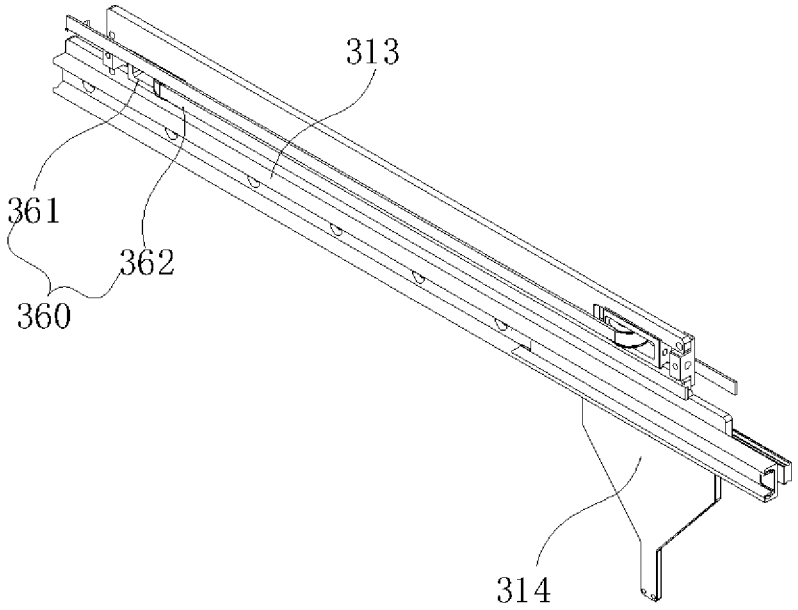


FIG. 5

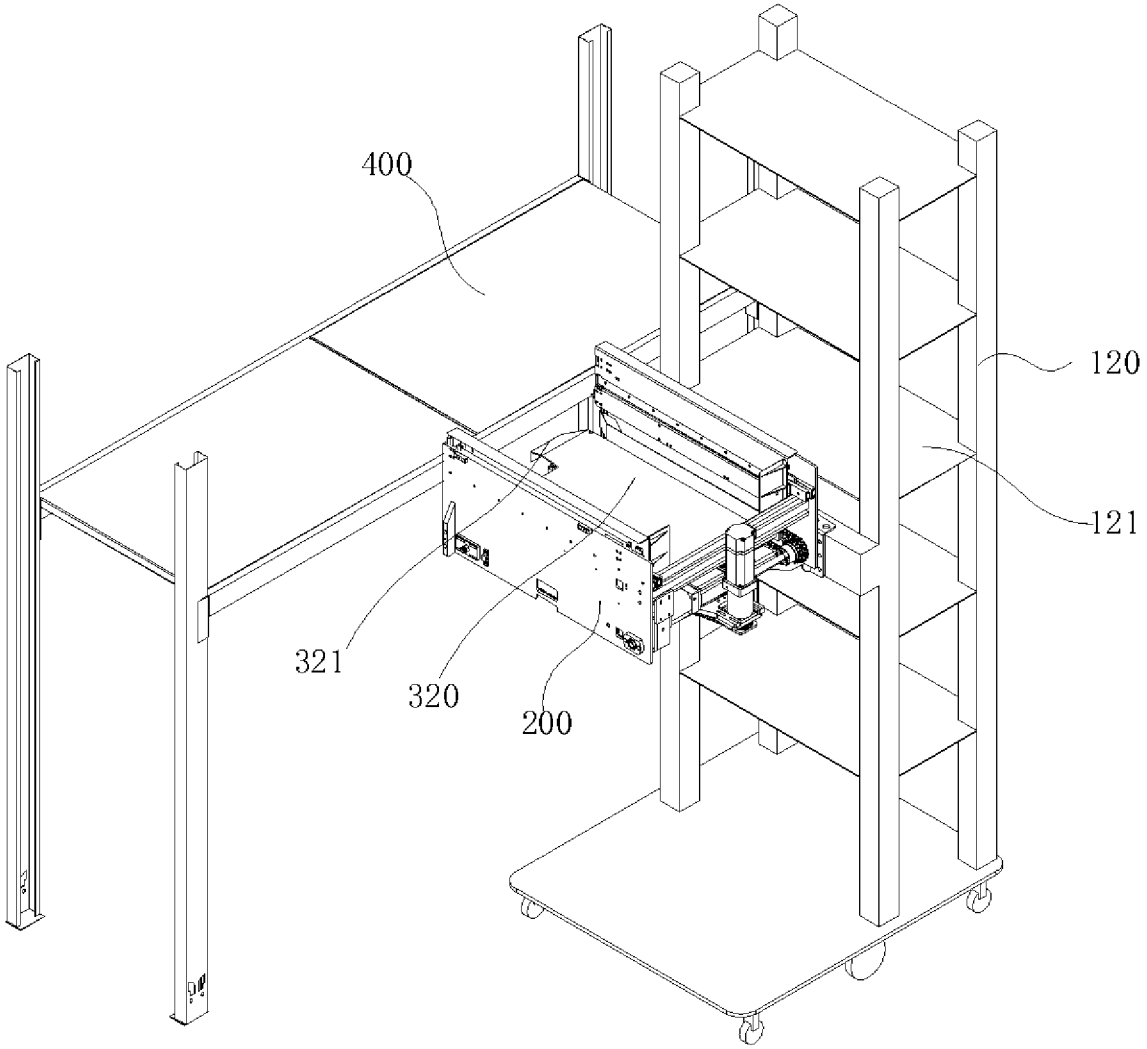


FIG. 6

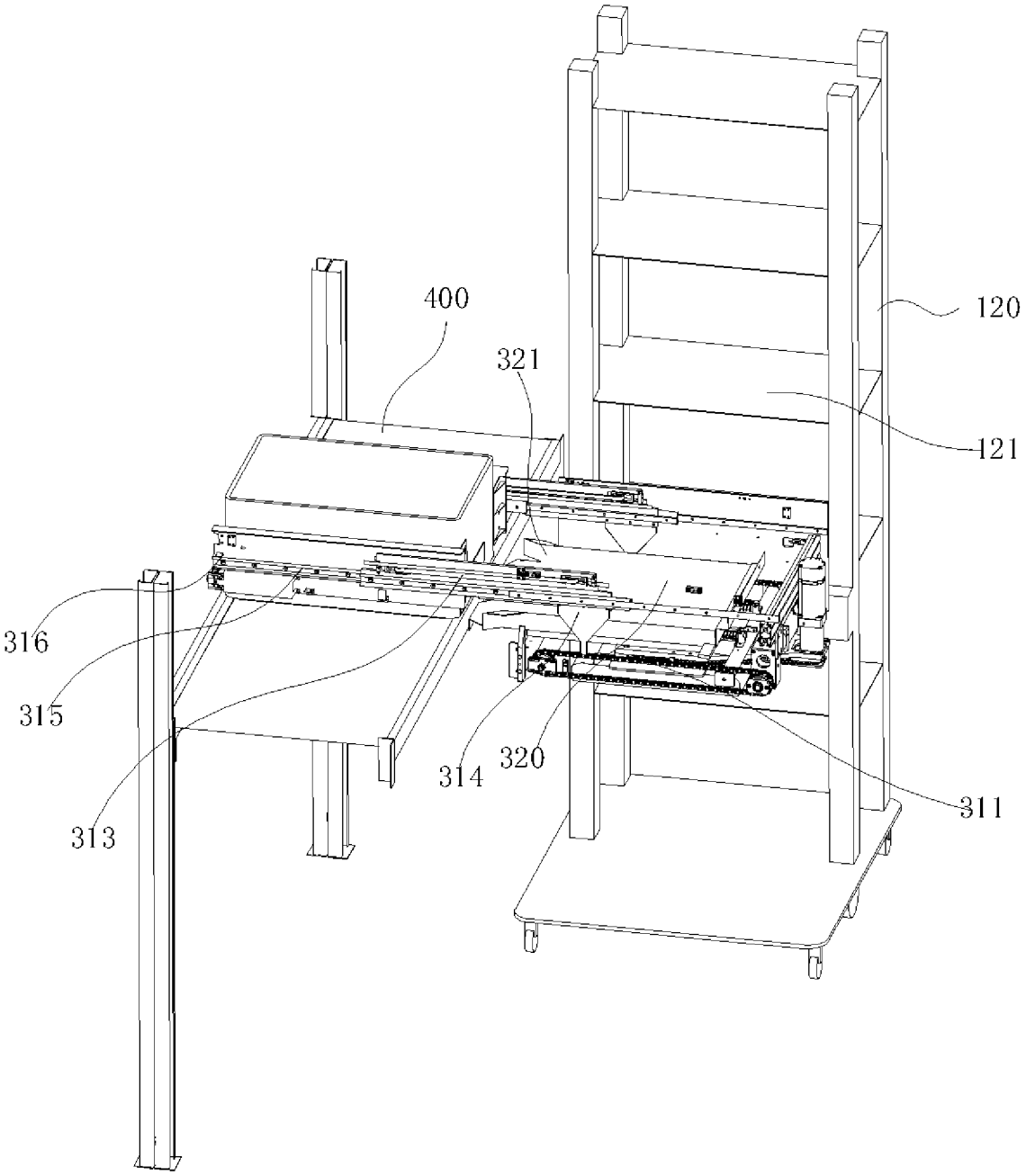


FIG. 7

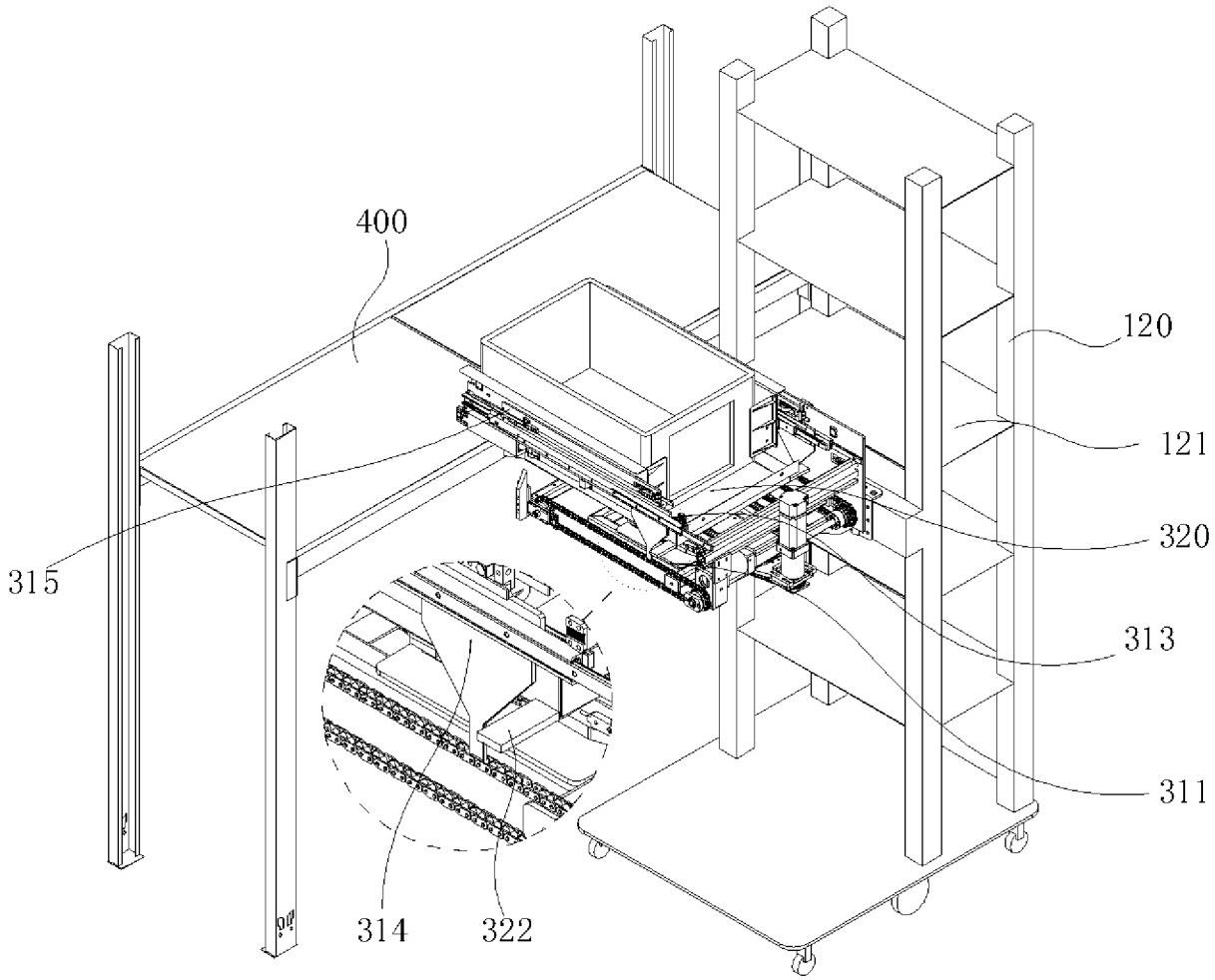


FIG. 8

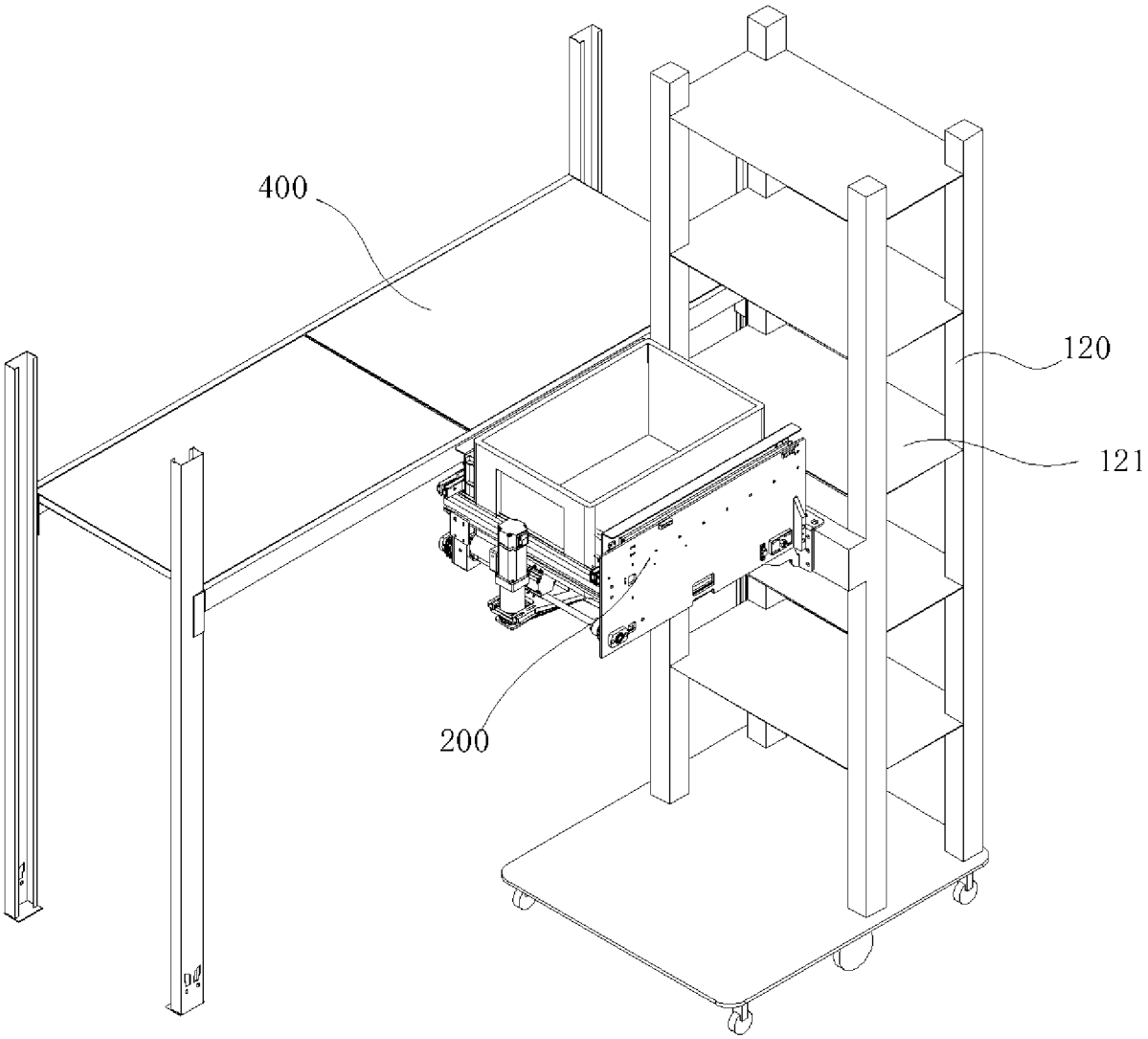


FIG. 9

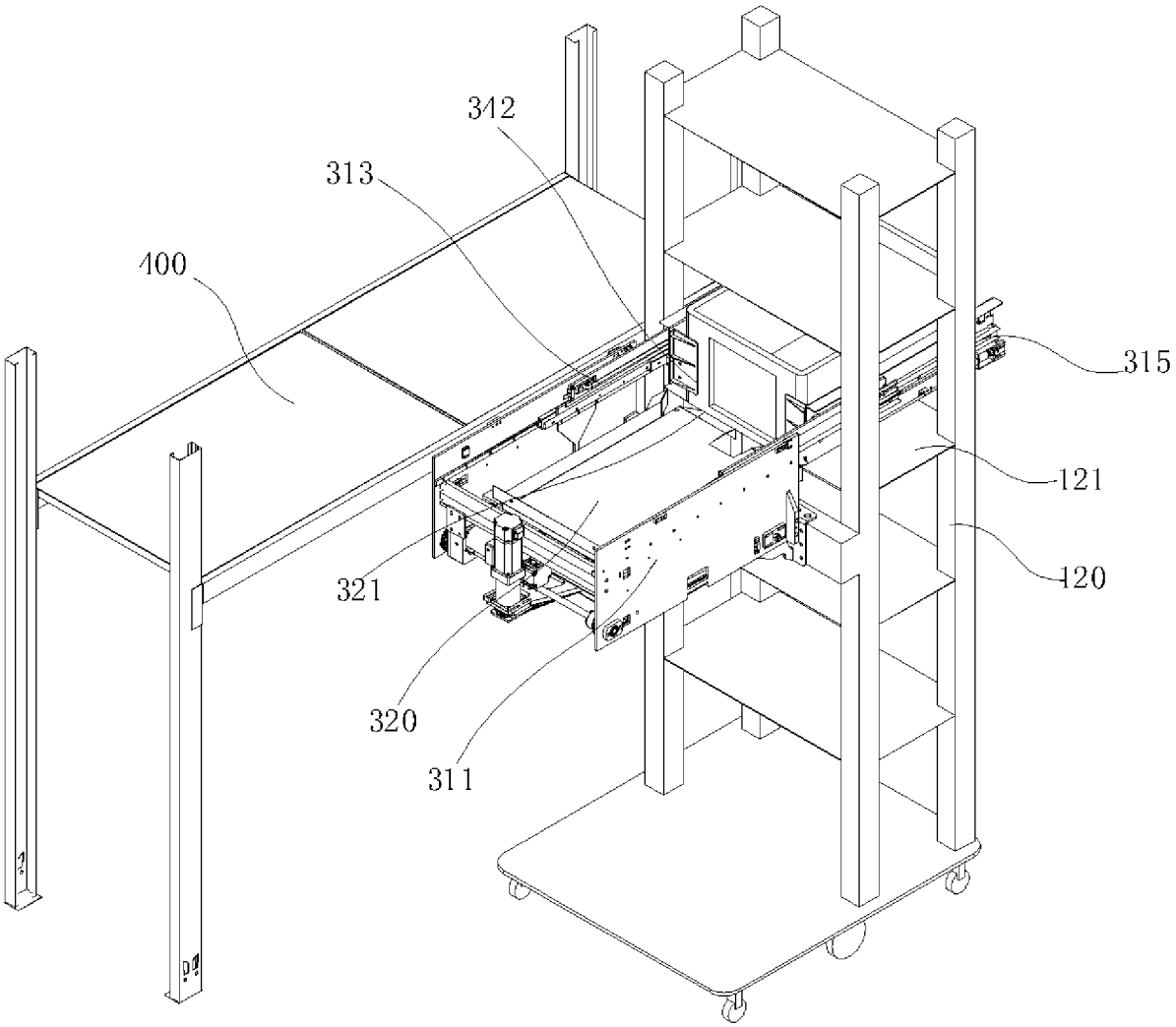
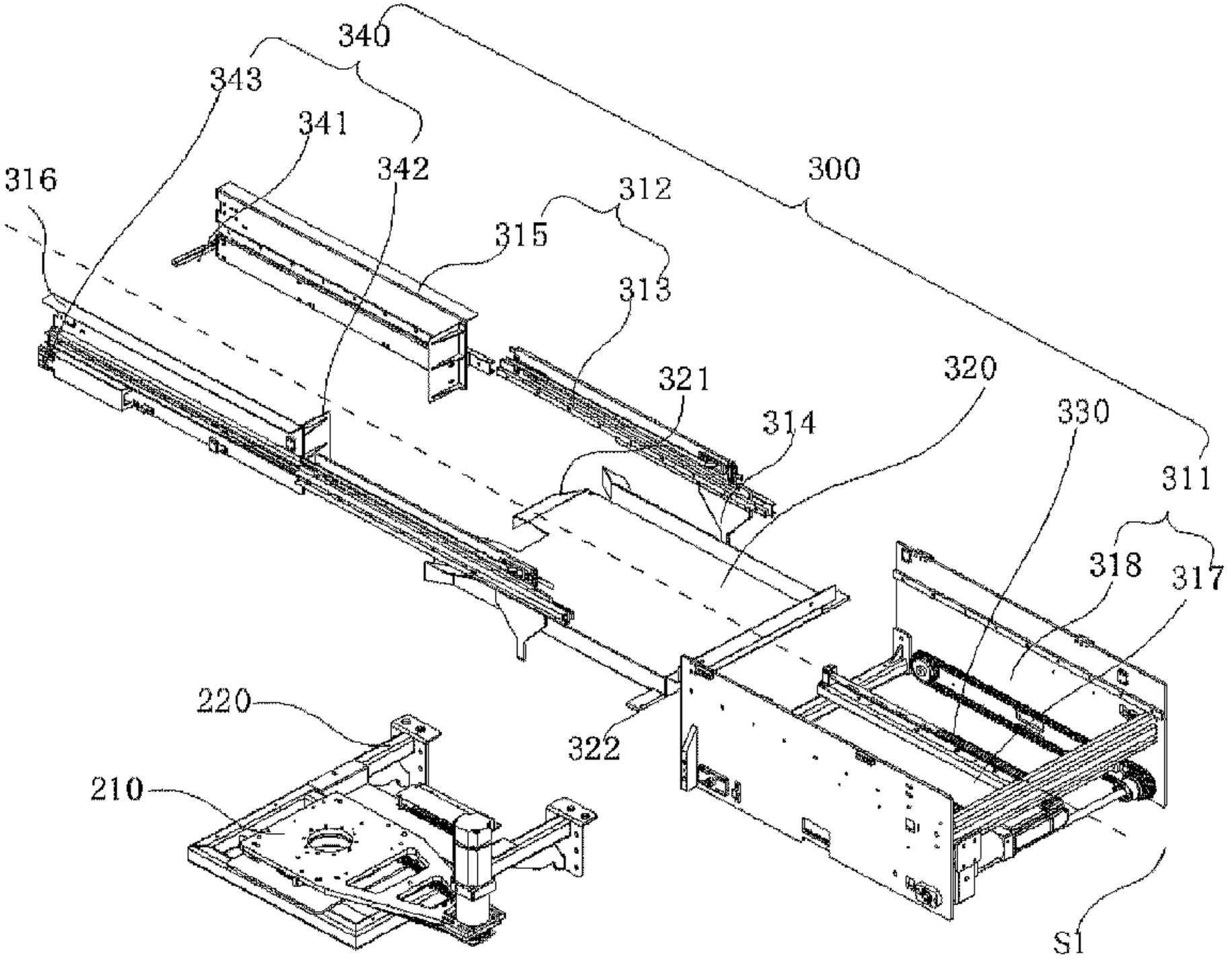


FIG. 10


340
343
341
342
316
312
315
313
300
321
320
314
330
311
318
317
220
210
322
S1