US010640307B2

(12) **United States Patent**
Sun et al.

(10) **Patent No.: US 10,640,307 B2**
(45) **Date of Patent: May 5, 2020**

(54) **SEPARATION MECHANISM AND FEEDING DEVICE FOR MATERIAL TRAY**

(71) Applicant: **World Precision Manufacturing (Dongguan) Co., Ltd.**, Dongguan (CN)

(72) Inventors: **Jinsuo Sun**, Dongguan (CN); **Yu Shen**, Dongguan (CN)

(73) Assignee: **WORLD PRECISION MANUFACTURING (DONGGUAN) CO., LTD.**, Dongguan (CN)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **16/116,684**

(22) Filed: **Aug. 29, 2018**

(65) **Prior Publication Data**

US 2018/0362271 A1 Dec. 20, 2018

(30) **Foreign Application Priority Data**

Apr. 9, 2018 (CN) 2018 1 0312511

(51) **Int. Cl.**

B65G 59/02	(2006.01)
B65G 47/91	(2006.01)
B25J 15/02	(2006.01)
B65G 61/00	(2006.01)
B65G 43/08	(2006.01)
B65G 59/10	(2006.01)

(52) **U.S. Cl.**

CPC ***B65G 59/02*** (2013.01); ***B25J 15/0226*** (2013.01); ***B65G 43/08*** (2013.01); ***B65G 47/917*** (2013.01); ***B65G 61/00*** (2013.01); *B65G 59/107* (2013.01); *B65G 2201/022* (2013.01)

(58) **Field of Classification Search**

CPC B65G 59/02; B65G 43/08; B65G 61/00; B65G 47/917; B65G 59/107; B65G 2201/022; B25J 15/0226

USPC 414/795.4; 294/203, 94, 110.2, 114, 116

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,888,341	A *	6/1975	Konkal	B23Q 1/28 198/345.3
5,347,928	A *	9/1994	Ito	B41F 27/1206 101/415.1
5,348,441	A *	9/1994	Takemasa	B23P 19/001 414/788.7
5,607,278	A *	3/1997	Mojden	B65G 47/5181 294/116

(Continued)

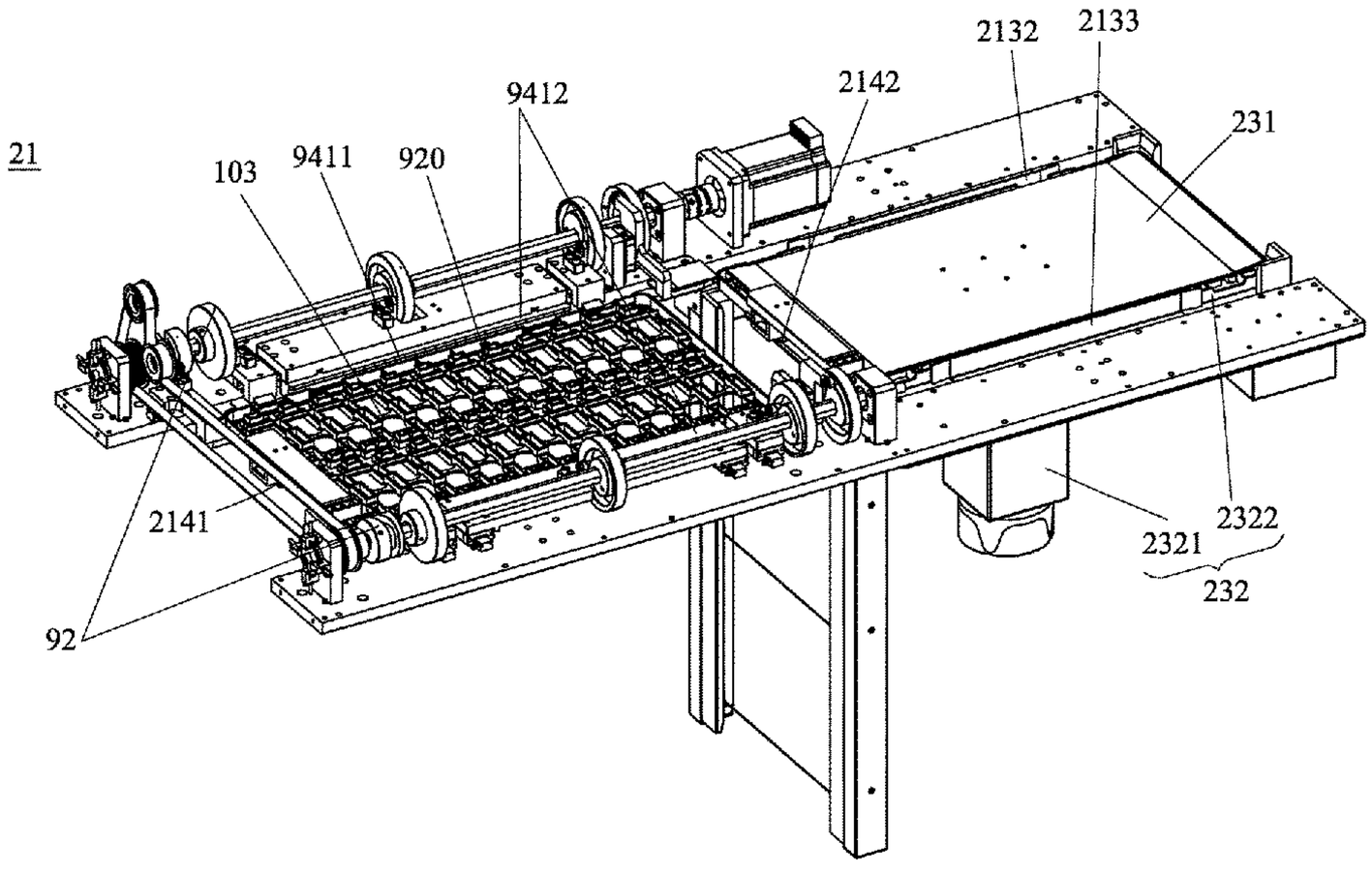
Primary Examiner — Lynn E Schwenning

(74) *Attorney, Agent, or Firm* — Shimokaji IP

(57) **ABSTRACT**

A separation mechanism includes a body frame, a clamping mechanism, a lifting assembly, and a material frame. The clamping mechanism includes a driving motor mounted on the body frame, two rotating shafts driven by the driving motor, and at least one clamping assembly. A separation area is formed between the two rotating shafts. The clamping assembly includes a main cam mounted on the respective rotating shaft and a main clamping block following the main cam. The main cams being configured that when the rotating shafts rotate to an initial station, the main cams drive the main clamping blocks to withdraw to release the material tray, and when the rotating shafts rotate to a clamping station, the main cams drive the main clamping blocks to stretch to clamp the material tray. A feeding device is also provided, which is simple in structure, small in size, and convenient to control.

8 Claims, 8 Drawing Sheets



(56) **References Cited**

U.S. PATENT DOCUMENTS

5,882,174	A *	3/1999	Woemer	B65G 60/00 414/788.7
2011/0286829	A1 *	11/2011	Xu	B65G 59/02 414/796.7
2012/0076631	A1 *	3/2012	Wang	B65G 57/302 414/792.7

* cited by examiner

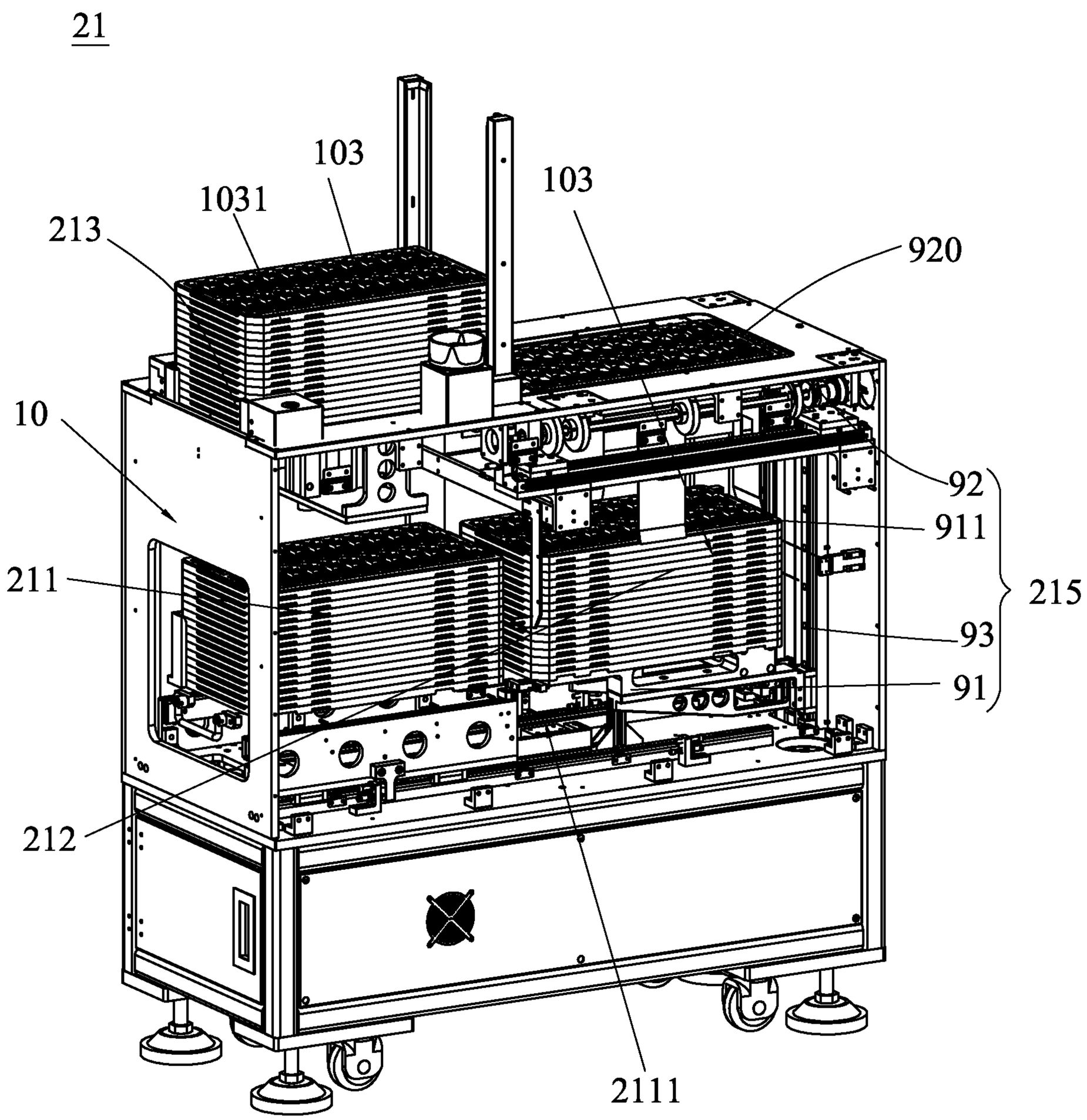


Fig. 1

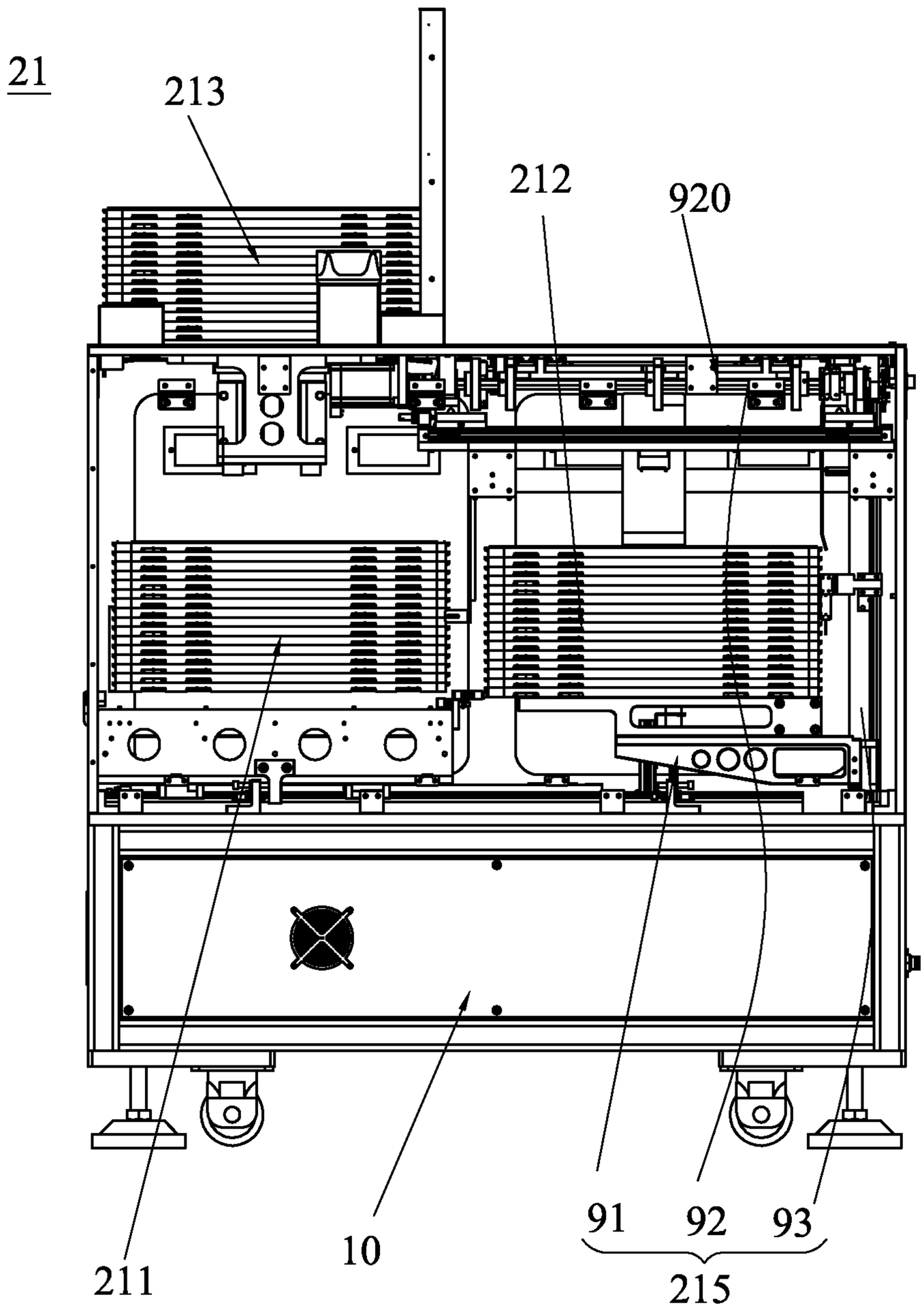


Fig. 2

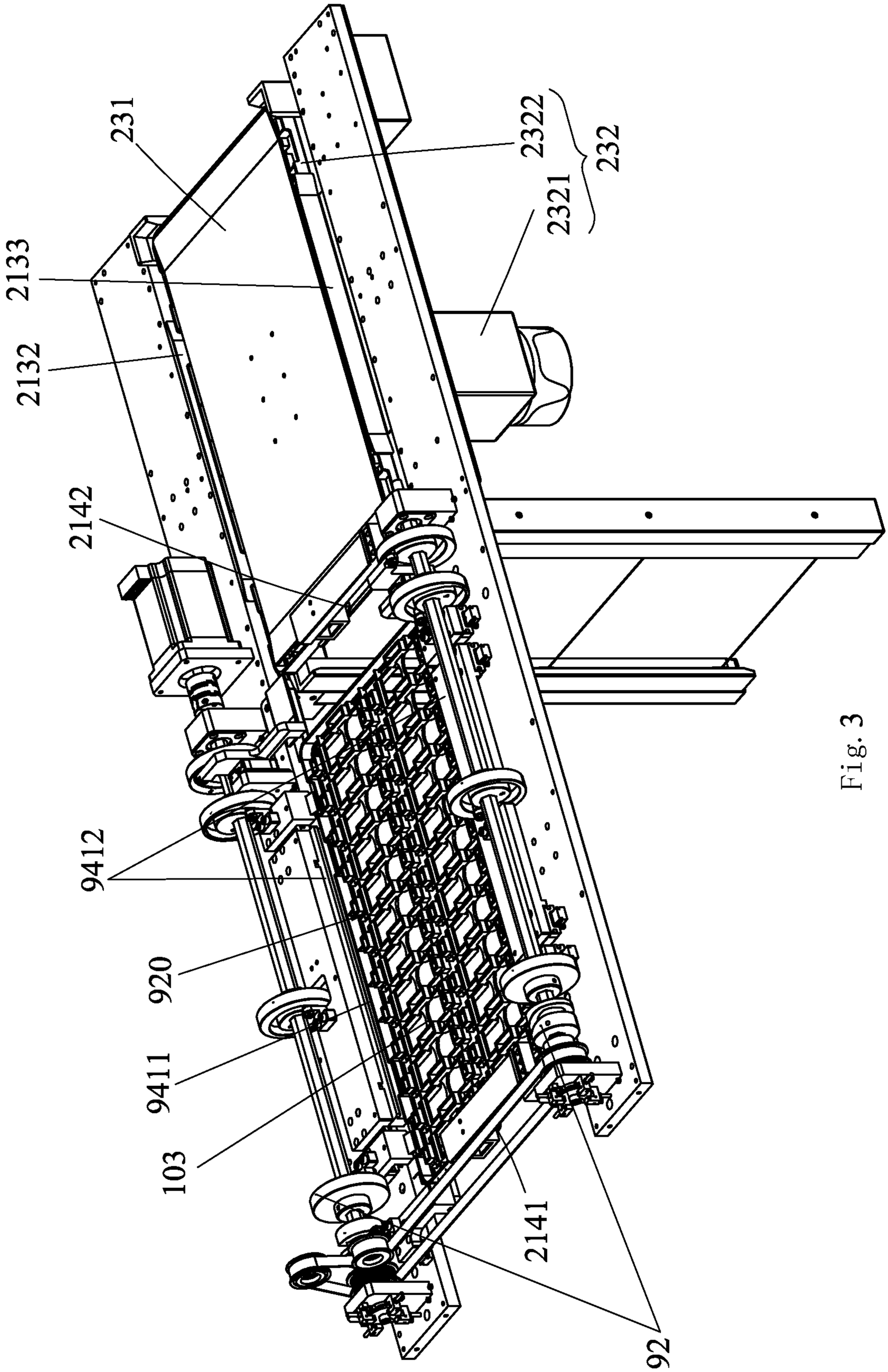


Fig. 3

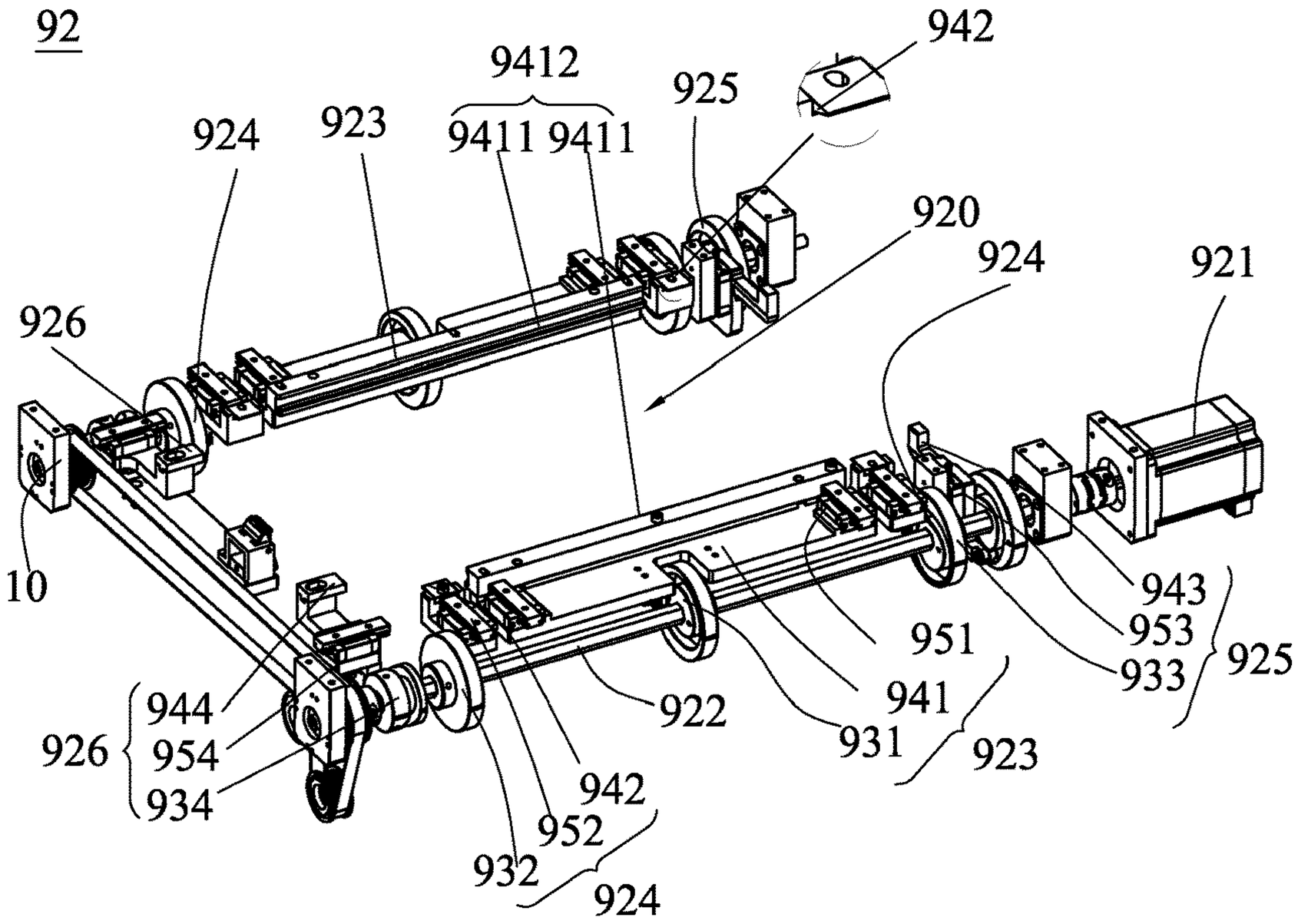

92
942
9412
925
924
923
9411 9411
920
924
921
926
10
943
953
933
925
951
941
931
923
944
954
934
926
922
942
952
932
924

Fig. 4

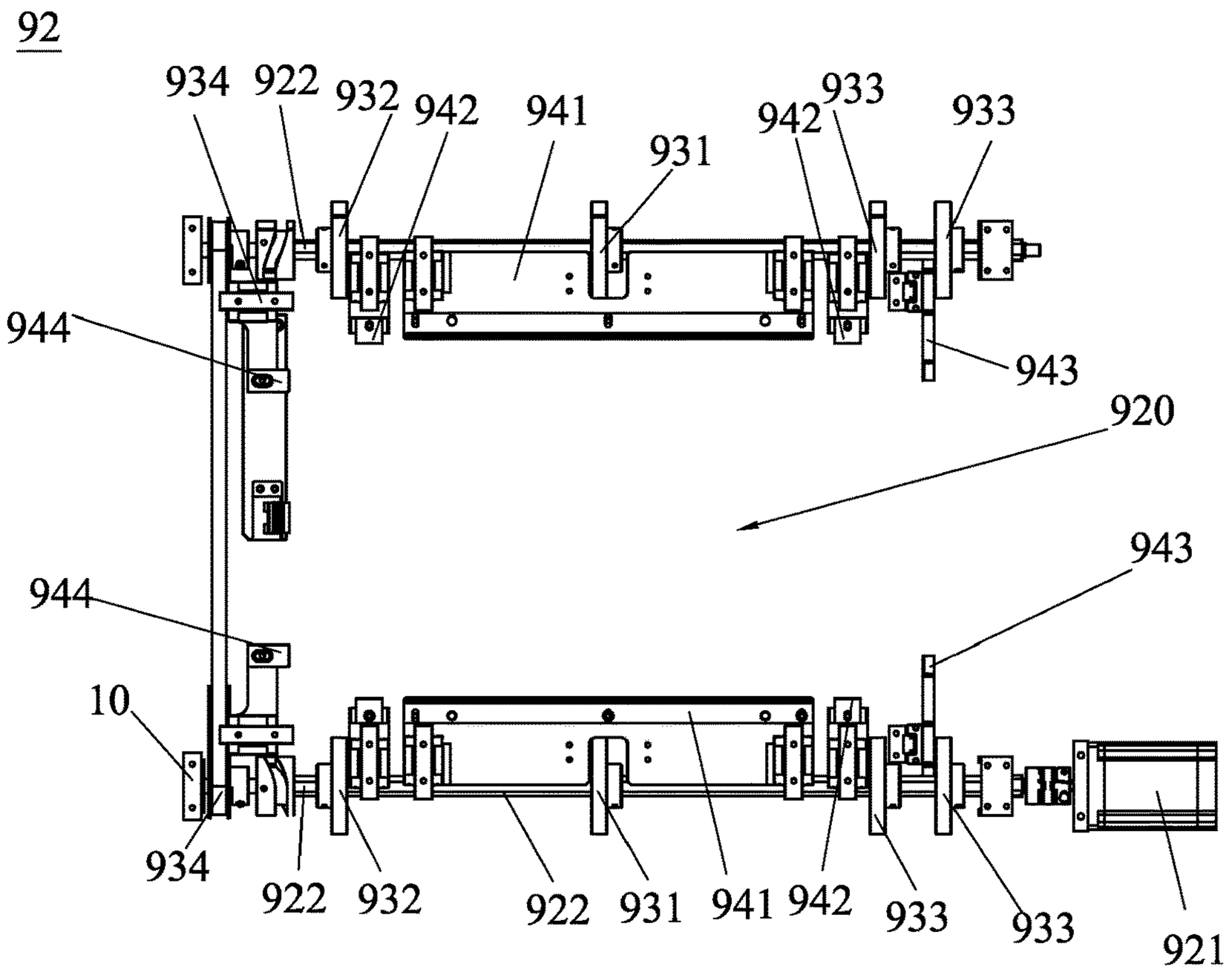

92
934
922
932
942
941
931
942
933
933
944
943
920
944
943
10
934
922
932
922
931
941
942
933
933
921

Fig. 5

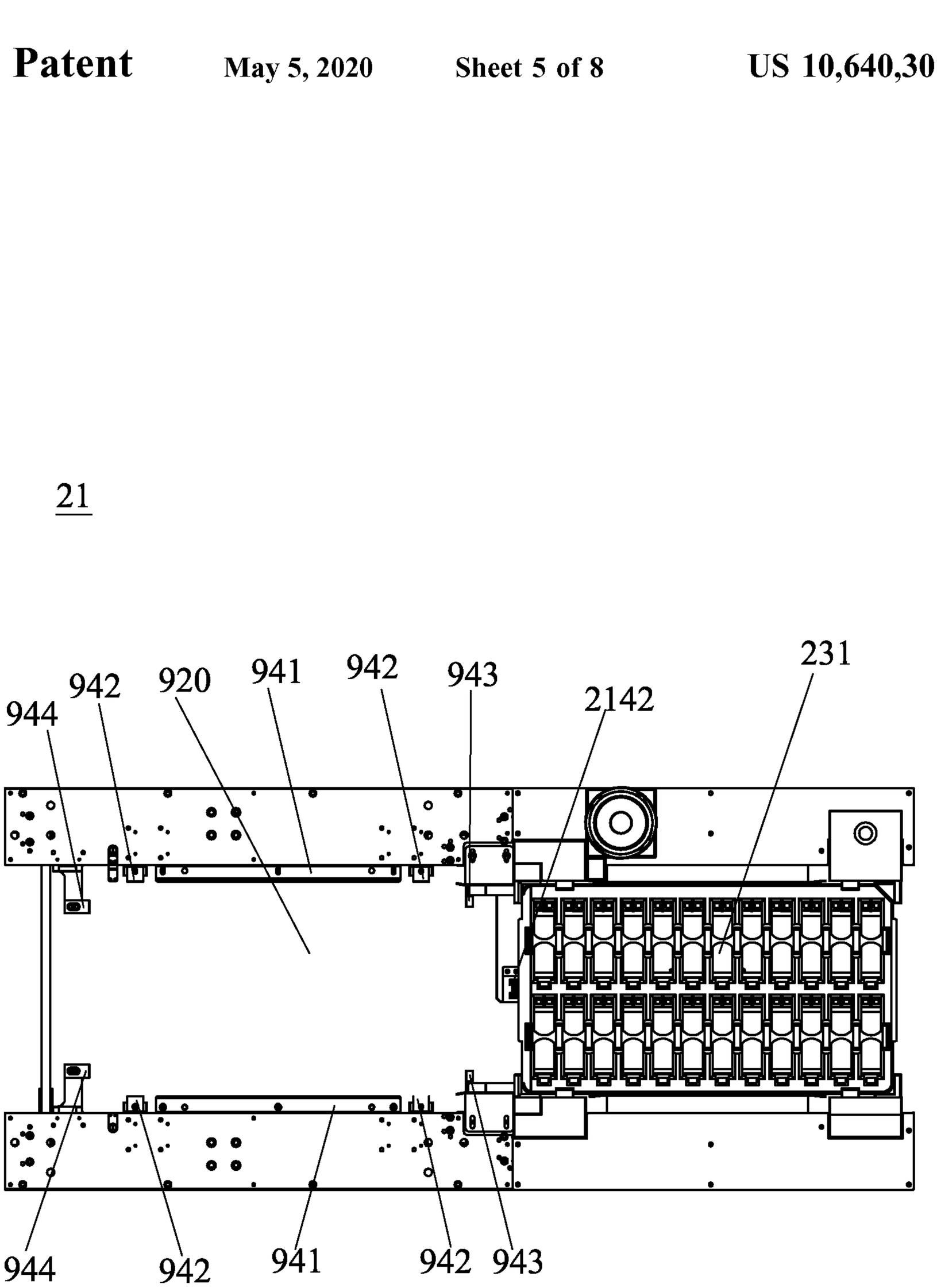


Fig. 6

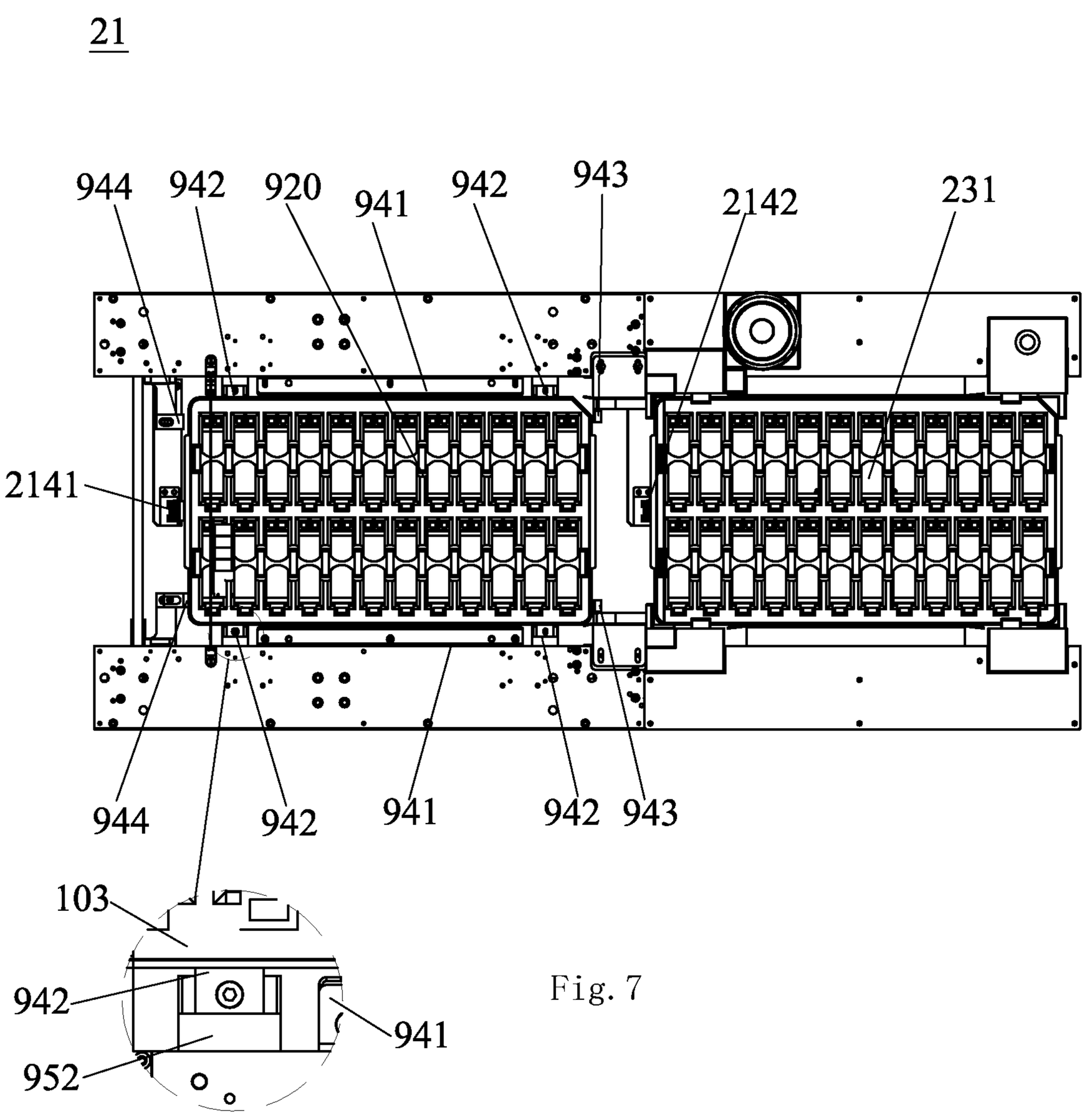

21
944
942
920
941
942
943
2142
231
2141
944
942
941
942
943
103
942
941
952

Fig. 7

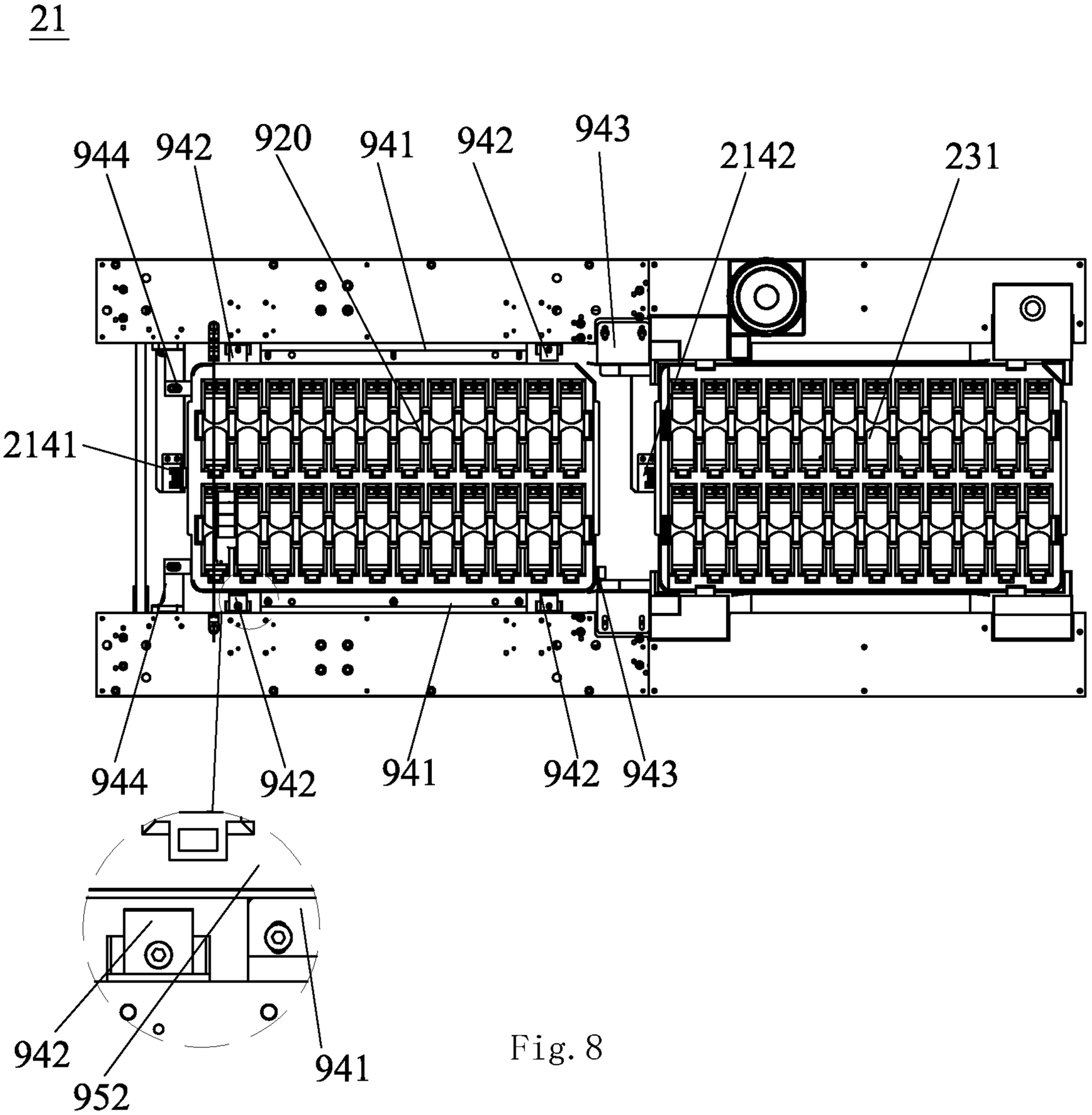

21
944
942
920
941
942
943
2142
231
2141
944
942
941
942
943
942
952
941

Fig. 8

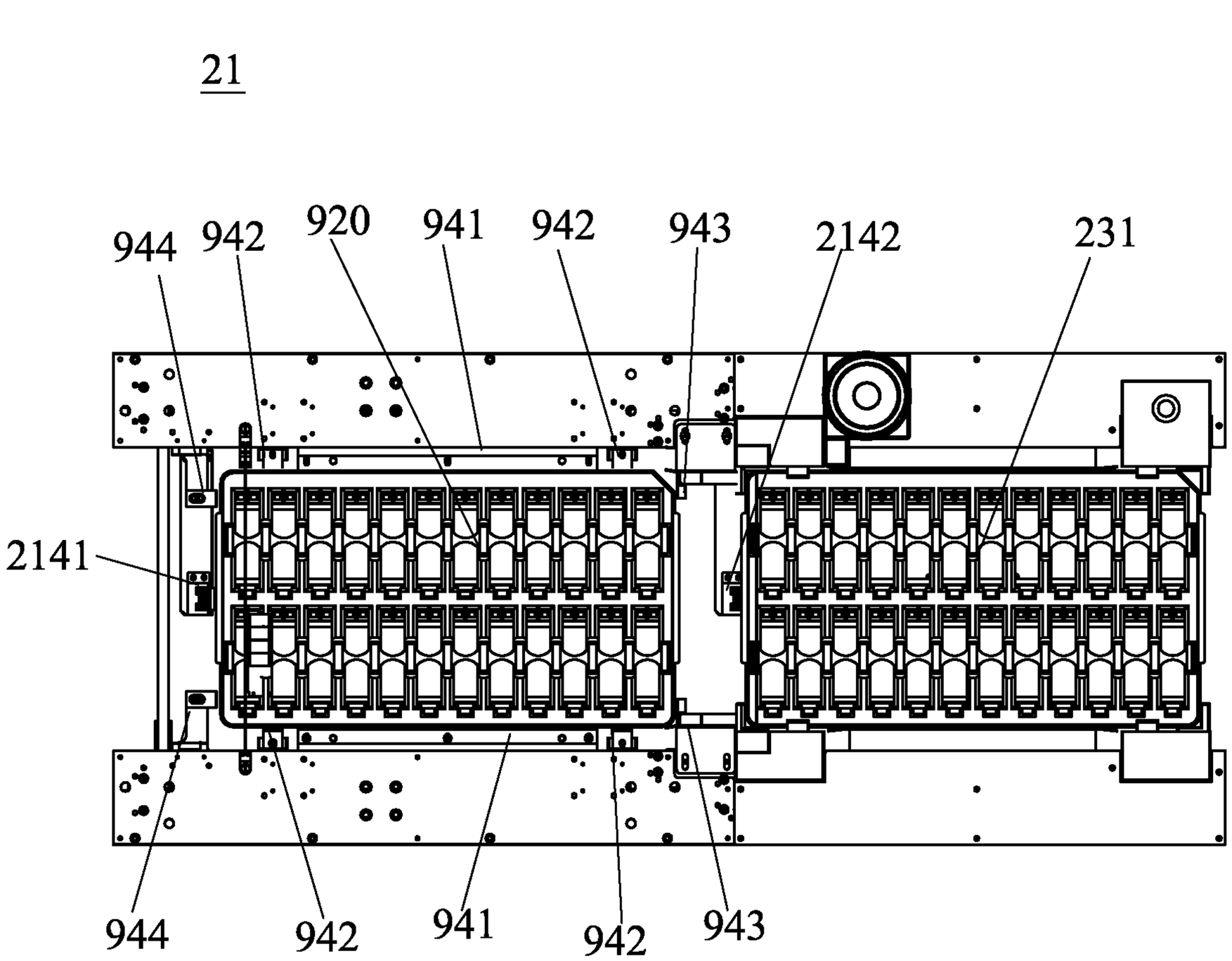


Fig. 9

SEPARATION MECHANISM AND FEEDING DEVICE FOR MATERIAL TRAY

RELATED APPLICATIONS

This application claims the benefit of priority to Chinese Patent Application No. 201810312511.5 filed on Apr. 9, 2018, which is hereby incorporated by reference in its entirety.

FIELD OF THE INVENTION

The present invention relates to a field of material conveying, and more particularly to a separation mechanism for separating stacked material tray and a feeding device for feeding the material tray.

BACKGROUND OF THE INVENTION

Commonly, in order to improve efficiency and save space, disc-shaped or sheet objects are often stacked together for storage and transport. In use, they must be separated from each other. Existing robots and suckers are often used to suck and transport discs, sheets, or things like that to separate and feed them, but their structures are complex and bulky. In use, they not only occupy too much space, but also need to control the movement of the sucker and the movement of the robot, and the control is complicated.

Thus, it's necessary to provide a separation mechanism that is small in size, simple in structure, and convenient to control.

SUMMARY OF THE INVENTION

One objective of the present invention is to provide a separation mechanism for separating stacked material trays, which is simple in structure, small in size, and convenient to control.

Another objective of the present invention is to provide a feeding device with a separation mechanism for separating stacked material trays and feeding the material tray, which is simple in structure, small in size, and convenient to control.

To achieve the above objective, a separation mechanism is provided, which includes a first frame structure, a clamping mechanism, a lifting assembly, and a second frame structure with a material area. The clamping mechanism includes a driving motor mounted on the first frame structure, two rotating shafts driven by the driving motor, and at least one clamping assembly arranged on the rotating shafts. A separation area is formed between the two rotating shafts and located above the material area. Each of the clamping assembly includes two main clamping portions located on left and right sides of the separation area, and each of the main clamping portions includes a main cam mounted on the respective rotating shaft and a main clamping block following the main cam. The two main cams respectively drive the two main clamping blocks to extend into and withdraw from the separation area. The rotating shafts rotate between an initial station and a clamping station. The main cams are configured that when the rotating shafts rotate to the initial station, the main cams drive the main clamping blocks to withdraw to release the material tray, and when the rotating shafts rotate to the clamping station, the main cams drive the main clamping blocks to extend to clamp the material tray. The lifting assembly controls relative movement of the clamping mechanism and the second frame structure.

In comparison with the prior art, the lifting assembly cooperating with the cams separates the material trays without clamping the material trays by a robot, and the clamping mechanism is located above the second frame structure, which effectively save space occupied by the separation mechanism. Only by controlling the rotating shaft, the clamping assembly extends into and withdraws from the separation area. The control is simple and easy to operate. In addition, the clamping mechanism clamps stably the material trays, which is less prone to operational errors.

Preferably, the clamping mechanism further includes a holding assembly, which includes two holding portions arranged respectively on the two rotating shafts and located on left and right sides of the separation area. Each of the holding portions includes a holding cam and a holding block following the holding cam. The two holding cams respectively drive the two holding blocks to extend into and withdraw from the separation area. The rotating shafts rotate between four stations. The holding cams are configured that when the rotating shafts rotate between the initial station and a holding station, the holding cams drive the holding blocks to extend to hold the material tray at the holding station, when the rotating shafts rotate between the holding station and an unloading station, the holding cams drive the holding blocks to withdraw to release the material tray at the unloading station, and when the rotating shafts rotate between the holding station and the clamping station, the main cams drive the main clamping blocks to extend to clamp the material tray before the holding blocks withdraw completely. Therefore, the material tray can be initially fixed by the holding assembly, and then the lifting assembly is lifted to separate the material trays, and then the material tray is clamped by the main clamping portion to facilitate subsequent operations.

Preferably, the number of the holding assembly is two, which are respectively located on both sides of the main clamping assembly, so that the material tray clamped is more stable.

Preferably, when the rotating shafts rotate from the unloading station to the initial station, the lifting assembly controls the second frame structure to approach the clamping mechanism, and moves the material tray on the top of the material area to the separation area at the initial station. When the rotating shafts rotate from the holding station to the clamping station, the lifting assembly controls the second frame structure to be away from the clamping mechanism, and the material tray at the top of the material area is separated from the second frame structure at the clamping station.

Preferably, the clamping mechanism further includes a subordinate clamping assembly. The subordinate clamping assembly includes a front clamping portion located on the front side of the separation area and a rear clamping portion located on the rear side of the separation area. The front clamping portion includes a front cam and a front clamping block, and the rear clamping portion includes a rear cam and a rear clamping block. Concretely, the front cam drives the front clamping block to extend towards or withdraw from the front edge of the separation area, and the rear cam drives the rear clamping block to extend out or withdraw from the rear edge of the separation area. The rotating shafts rotate between four stations. The front cam and the rear cam are configured that when the rotating shafts rotate to the initial station, the front cam and the rear cam respectively drive the front clamping block and the rear clamping block to withdraw to release the material tray, when the rotating shafts rotate between the initial station and the holding station, the

front cam drives the front clamping block to extend to the front edge of the separation area, when the rotating shafts rotate between the holding station and the clamping station, the rear cam drives the rear clamping block to extend to the rear edge of the separation area to clamp the material tray, and when the rotating shafts rotate between the clamping station and the unloading station, the front cam and the rear cam drive the front clamping block and the rear clamping block to withdraw to release the material tray.

Preferably, the main clamping portion further includes a guiding element fixed to the first frame structure. The main clamping block is movably engaged with the guiding element and moved under the limitation of the guiding element.

Concretely, the guiding element is a first guide rail. The main clamping block is slidably engaged with the first guide rail. Preferably, the first guide rail of the main clamping assembly is horizontally disposed.

Preferably, a sliding groove is defined on the main clamping block for the material tray sliding. The sliding grooves of the two main clamping blocks form a sliding rail for the material tray sliding. After being clamped, the material tray can move and quickly be away from the separation area through the sliding groove.

Preferably, before the rotating shafts rotate to the initial station, the lifting assembly controls the second frame structure to approach the clamping mechanism, and moves the material tray on the top of the material area to the separation area at the initial station. After the rotating shafts rotate to the clamping station, the lifting assembly controls the second frame structure to be away from the clamping mechanism, and the material tray at the top of the material area is separated from the material area at the clamping station.

A feeding device is also provided, which includes a feeding box and a transfer mechanism, and an above-mentioned separation mechanism. The separation mechanism is installed in the feeding box, and the separation area is located at an upper opening of the feeding box. The lifting assembly is connected with the second frame structure and controls the second frame structure to lift or fall, then to drive the clamping mechanism and the second frame structure to move relative to each other. A sliding groove is defined on the main clamping block for the material tray sliding, and the sliding grooves of the two main clamping blocks are opposite to form a sliding rail for the material tray sliding.

In comparison with the prior art, the lifting assembly cooperating with the cams separates the material trays without clamping the material trays by a robot, and the clamping mechanism is located above the second frame structure, which effectively save space occupied by the separation mechanism. Only by controlling the rotating shaft, the clamping assembly extends into and withdraws from the separation area. In addition, the clamping assembly clamps stably the material trays, which is less prone to operational errors. Furthermore, the second frame structure for storing the stacked material trays, the clamping mechanism for clamping the material tray, and the transfer mechanism for transferring the material tray are placed in the feeding box, and the structure is simple.

Preferably, the feeding device further includes a stacking assembly, which includes a stacking table, a lifting mechanism, and a second guide rail communicating with the sliding rail on the stacking table. The stacking table is provided with a guide rail communicating with the sliding rail, the transfer mechanism drives the material tray to move along the sliding rail to the stacking table, and the lifting mechanism lifts the material tray on the stacking table.

Preferably, the lifting mechanism includes a drive mechanism and an ejecting block. Concretely, the drive mechanism is arranged under the stacking table, and the ejecting blocks are positioned on both sides of the stacking table. When the lifting mechanism operates, the ejecting block is lifted up to eject the material tray on the stacking table.

Preferably, the feeding device further includes a storage box, which has a material transfer track communicated with the second frame structure. The material transfer track carries the stacked material trays and conveys them to the second frame structure.

Preferably, the stacking table is located at the top of the storage box, thereby effectively saving space.

Preferably, the transfer mechanism includes switching blocks installed on the first frame structure and located on front and rear sides of the separation area. The switching blocks rotate to toggle the material tray to slide along the sliding rail. Preferably, the transfer mechanism has a simple structure and a small volume.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings facilitate an understanding of the various embodiments of this invention. In such drawings:

FIG. **1** is a perspective view of a feeding device according to the present invention;

FIG. **2** is a side view of the feeding device according to the present invention;

FIG. **3** is a partial perspective view of the feeding device according to the present invention;

FIG. **4** is a perspective view of a clamping mechanism according to the present invention;

FIG. **5** is a bottom plan view of the clamping mechanism according to the present invention; and

FIGS. **6-9** are a top view illustrating the clamping mechanism in its four stations according to the present invention.

DETAILED DESCRIPTION OF ILLUSTRATED EMBODIMENTS

A distinct and full description of the technical solution of the present invention will follow by combining with the accompanying drawings.

Referring to FIGS. **1** and **2**, a feeding device **21** for feeding material tray to a production line, includes a feeding box **212** and a transfer mechanism (**2141**, **2142**) (as shown in FIG. **6**). The separation mechanism **215** is installed in the feeding box **212**.

Referring to FIGS. **1** and **2**, the separation mechanism **215** is provided, which includes a clamping mechanism **92**, a lifting assembly **93**, and a second frame structure **91** with a material area **911**. The clamping mechanism **92** is located at an upper opening of the feeding box **212**. The clamping mechanism **92** cooperating with the lifting assembly **93** separates the stacked material tray **103** on the second frame structure **91** in the feeding box **212**. In this embodiment, the material tray **103** is used for holding material. Therefore, the clamping mechanism **92** above the feeding box **212** is also formed with a feeding area. The conveying mechanism on the production line can directly take material from the feeding area. After taking the material, the material tray **103** can be removed from the clamping mechanism **92** by the transfer mechanism (**2141**, **2142**).

Referring to FIGS. **4** and **5**, the clamping mechanism **92** includes a driving motor **921** mounted on the first frame structure **10**, two rotating shafts **922** driven by the driving motor **921**, and the two main clamping portions **923** respectively mounted on the two rotating shafts **922**. A separation area **920** is formed between the two rotating shafts **922** and located above the material area **911**. The main clamping portion **923** includes a main cam **931**, a main clamping block **941**, and a first guide rail **951**. The main cam **931** is mounted on the rotating shaft **922**, the main clamping block **941** follows the main cam **931**, and the first guide rail **951** is horizontally disposed and connected to the first frame structure **10**. The two rotating shafts **922** respectively drive the two main cams **931** to rotate. The main clamping block **941** is slidably connected to the first guide rail **951**. The main cam **931** drives the main clamping block **941** to extend into or withdraw from the separation area **920** to clamp or release the material tray **103**. The rotating shaft **922** is sequentially provided with an initial station and a clamp station on rotational position thereof. As shown in FIG. **6**, when the rotating shafts **922** rotate to the initial station, the main cams **931** drive the main clamping blocks **941** to withdraw to release the material tray **103**. When the rotating shafts **922** rotate between the initial station and the clamping station, the main cams **931** drive the main clamping blocks **941** to extend out at the clamping station. Or, the rotating shaft **922** rotates between the clamping station and the initial station, the main cams **931** drive the main clamping block **941** to withdraw at the initial station. Specifically, the driving motor **921** is a stepping motor. Of course, the lifting assembly **93** may also be connected to the clamping mechanism **92**, and the clamping mechanism **92** is controlled to lift and lower to separate relatively the clamping mechanism **92** and the second frame structure **91**.

In this embodiment, the lifting assembly **93** is connected to the second frame structure **91** for lifting or lowering the second frame structure **91**, so that the clamping mechanism **92** and the second frame structure **91** move relative to each other.

Preferably, as shown in FIG. **4**, a sliding groove **9411** is defined on the main clamping block **941** for the material tray **103** sliding. The sliding grooves **9411** of the two main clamping blocks form a sliding rail **9412** for the material tray **103** sliding. In this embodiment, cross-section of the sliding groove **9411** is "U" shaped.

Of course, the first guide rail **951** of the main clamping portion **923** uses other guiding element, such as an inclined curved track. Or the guiding element may be removed, and the main clamping block **941** is directly configured on the main cam **931**. Alternatively, the guiding element is connected to the main cam **931** by a spring member. At this time, cross section of the sliding groove **9411** is "L" shaped.

Specifically, the lifting assembly **93** controls the second frame structure **91** to rise before reaching the initial station, so that the material tray **103** on the top of the material area **911** is moved to the separation area **920** at the initial station; after the clamping station, the second frame structure **91** descends, thereby separating the material tray **103** on the top of the material area **911** from the second frame structure **91**.

Referring to FIGS. **1-3**, the feeding device **21** further includes a stacking assembly **213**, which includes a stacking table **231**, a lifting mechanism **232**, and a second guide rail communicating with the sliding rail **9412**. The second guide rail is formed by the bottom surface of the stacking table **231** and two side walls **2132** and **2133**. The transfer mechanism (**2141**, **2142**) is located at an upper opening of the feeding box **212** and drives the material tray **103** on the sliding rail **9412** to move along the sliding rail **9412** to the stacking table **231**. The lifting mechanism **232** includes a drive mechanism **2321** and an ejecting block **2322**. The ejecting blocks **2322** are positioned on both sides of the stacking table **231** and face edge of the material tray **103**. When the transfer mechanism (**2141**, **2142**) operates, the ejecting block **2322** lifts up the material body **103** on the stacking table **231**.

Preferably, as shown in FIG. **1**, the feeding device **21** further includes a storage box **211**, and a material transfer track **2111** communicated with the second frame structure **91** is installed in the storage box **211**. The material transfer track **2111** carries the stacked material trays **103** and conveys them to the second frame structure **91**. The stacking table **231** is located at the top of the storage box **211**.

Referring to FIGS. **3** and **4**, the transfer mechanism (**2141**, **2142**) includes a switching block (**2141**, **2142**) rotatably installed on the first frame structure **10** and located on front and rear sides of the separation area **920**. The switching block rotates and toggles the material tray **103** to slide along the sliding rail **9412** until the material tray **103** is separated from the separation area **920** and enters the stacking table **231**.

Referring to FIGS. **3-5**, the clamping mechanism **92** further includes a holding assembly, which includes two holding portions **924** respectively mounted on the two rotating shafts **922**. The holding portion **924** includes a holding cam **932**, a holding block **942**, and a third guide rail **952**. Specifically, the holding cam **932** is mounted on the rotating shaft **922**, the holding block **942** follows the holding cam **932**, and the third guide rail **952** is connected to the first frame structure **10** and horizontally arranged. The two rotating shafts **922** respectively drive the two holding cams **932** to rotate, and the holding cam **932** is slidably connected to the third guide rail **952**. The holding cam **932** drives the holding block **942** to extend into and withdraw from the separation area **920** to clamp and release the material tray **103**.

An alignment groove **1031** is formed on the left and right sides of the material tray **103**. The holding block **942** cooperates with the alignment groove **1031** and inserts into the alignment groove **1031**, to hold the material tray **103**. Preferably, the holding block **942** is wedge-shaped.

The rotating shaft **922** rotates between four stations, namely an initial station, a holding station, a clamping station, and an unloading station along the rotation position of the rotating shaft **922**. At the initial station, the holding block **942** withdraws, thereby the holding portion **924** releasing. When the rotating shaft **922** rotates between the initial station and the holding station, the holding cam **932** drives the holding block **942** to extend to hold the material tray **103** at the holding station. Also, the rotating shaft **922** rotates between the holding station and the unloading station, the holding cam **932** drives the holding block **942** to withdraw to release the material tray **103** at the unloading station. Further, the rotating shaft **922** rotates between the holding station and the clamping station, the main cam drives the main clamping block **941** to extend to clamp the material tray **103** before the holding block **942** withdraw completely.

Preferably, the number of the holding portions **924** is four. Two holding portions **924** are in a group and located on the front and rear sides of the main clamping portion **923**.

Of course, the third guide rail **952** of the holding portion **924** also uses other guiding element, such as an inclined curved track. Or the guiding element may be removed, and the holding block **942** is directly formed on the holding cam

932. Alternatively, the guiding element is connected to the holding cam **932** by a spring member.

The lifting assembly **93** controls the material first frame structure **91** to rise at the initial station, so that the material tray **103** on the top of the material area **911** is moved to the separation area **920**. The second frame structure **91** descends at the holding station, thereby separating the material tray **103** on the top of the material area **911** from the second frame structure **91**.

Referring to FIGS. **3-5**, the clamping mechanism **92** further includes a subordinate clamping assembly (**925**, **926**). The subordinate clamping assembly includes a front clamping portion **925** and a rear clamping portion **926**. Specifically, the front clamping portion **925** is located on the front side of the separation area **920**, and the rear clamping portion **926** is located on the rear side of the separation area **920**. The front clamping portion **925** includes a front cam **933**, a front clamping block **943**, and a fourth guide rail **953**. Specifically, the front cam **933** is mounted on the rotating shaft **922**, the front clamping block **943** follows the front cam **933**, and the fourth guide rail **953** is connected to the first frame structure **10** and vertically arranged. The two rotating shafts **922** respectively drive the two front cams **933** to rotate, and the front cam **933** is slidably connected to the fourth guide rail **953**. The front cam **933** drives the front clamping block **943** to extend out and withdraw from the front edge of the separation area **920**. The rear clamping portion **926** includes a rear cam **934**, a rear clamping block **944**, and a fifth guide rail **954**. Specifically, the rear cam **934** is mounted on the rotating shaft **922**, the rear clamping block **944** follows the rear cam **934**, and the fifth guide rail **954** is connected to the first frame structure **10** and vertically arranged. The two rotating shafts **922** respectively drive the two rear cams **934** to rotate, and the rear cams **934** are slidably connected to the fifth guide rail **954**. The rear cam **934** drives the rear clamping block **944** to extend out and withdraw from the rear edge of the separation area **920**. The front cam **933** and the rear cam **934** drive respectively the front clamping block **943** and the rear clamping block **944** to extend out or withdraw.

Specifically, the number of the front clamping portion **925** is two, and the two front clamping portion **925** are mounted on the rotating shaft **922**; the number of the rear clamping portion **926** is two, and the two rear clamping portion **926** are mounted on the rotating shaft **922**.

In this embodiment, the rotating shaft **922** rotates between four stations. When the rotating shafts **922** rotate to the initial station, the front cam **933** and the rear cam **934** drive respectively the front clamping block **943** and the rear clamping block **944** to withdraw to release the material tray **103**. When the rotating shafts **922** rotate between the initial station and the holding station, the front cam **933** drives the front clamping block **943** to extend to the front edge of the separation area **920**. When the rotating shafts **922** rotate between the holding station and the clamping station, the rear cam **934** drives the rear clamping block **944** to extend to the rear edge of the separation area **920** to clamp the material tray **103**. When the rotating shafts **922** rotate between the clamping station and the unloading station, the front cam **933** and the rear cam **934** drive the front clamping block **943** and the rear clamping block **944** to withdraw to release the material tray **103**.

Of course, the fourth guide rail **953** also uses other guiding element, such as an inclined curved track. Or the guiding element may be removed, and the holding block **942** is directly formed on the holding cam **932**. Besides, the fourth guide rail **953** is not limited to the vertical arrangement.

Referring to FIG. **6** to FIG. **9**, the feeding device **21** according to this embodiment above at four stations is schematically illustrated, as follows:

(1) Referring to FIG. **6**, the clamping mechanism **92** is in an initial state, the main clamping block **941**, the holding block **942**, the front clamping block **943**, and the rear clamping block **944** withdraw from the separation area **920**, and the main clamping portion **923**, the holding portion **924** and the subordinate clamping assembly (**925**, **926**) are in a released state.

The lifting assembly **93** lifts the second frame structure **91**, so that the material tray **103** on the top of the material area **911** moves upward to the separation area **920**.

(2) The rotating shaft **922** rotates, and the holding cam **932** drives the holding block **942** to extend into the separation area **920**. When the rotating shaft **922** rotates 90 degrees from the initial position, the holding blocks **942** on the left and right sides of the separation area **920** are respectively inserted into the alignment grooves **1031** on both sides of the material tray **103**. And the holding portions **924** hold the material tray **103** from the left and right sides of the material tray **103** (as shown in FIG. **7**). The front cam **933** drives the front clamping block **943** to extend upwards to the front edge of the separation area **920**, (as shown in FIG. **7**). At this time, the front clamping block **943** is close to or contacts the front side of the material tray **103**. It is at the holding station at this time.

The lifting assembly **93** drives the second frame structure **91** to descend, so that the material tray **103** on the top of the second frame structure **91** are separated from other material trays. The separated material tray **103** is held on the holding block **942**.

(3) The rotating shaft **922** continues to rotate, and the rear cam **934** rotates to drive the rear clamping block **944** to extend to the rear edge of the separation area **920**. Then the rear clamping block **94** pushes the material tray **103** to touch the front clamping block **943**, and the subordinate clamping assembly (**925**, **926**) clamps the material tray **103**. At the same time, the main cam **931** drives the main clamping blocks **941** to extend into the separation area **920** and to insert into the material tray **103**. So the material tray **103** is positioned and slidably fits with the sliding rail **9412**. After the material tray **103** is positioned, the rotating shaft **922** continues to rotate. The holding cam **932** drives the holding block **942** to withdraw. When the rotating shaft **922** rotates 180 degrees from the initial position, the holding blocks **942** respectively exit from the alignment groove **1031** to release the material tray **103** (as shown in FIG. **8**). It is at the clamping station at this time.

(4) A feeding mechanism feeds material for the material tray **103**.

(5) After one material tray **103** finishes loading, the rotating shaft **922** continues to rotate. The front cam **933** drives the front clamping block **943** to withdraw (as shown in FIG. **9**). At this time, the front clamping block **943** leaves the front side of the material tray **103**, and the rear cam **934** drives the rear clamping block **934** to be away from the rear side of the material tray **103**. When the rotating shaft **922** rotates 270 degrees from the initial position, the subordinate clamping assembly (**925**, **926**) is in a released state. It is at the unloading station at this time.

(6) The switching blocks rotate back and forth to toggle the material tray **103** to slide along the sliding rail **9412** until it is separated from the separation area **920** and enters the

stacking table **231**. After the material tray **103** is separated from the separation area **920**, the rotating shaft **922** continues to rotate. The main cam **931** drives the main clamping block **941** to withdraw from the separation area **920**. The main clamping portion **923** is in the released state, and it is at the initial station (as shown in FIG. **6**).

In the above, the rotating shaft **922** is provided with four stations, and each 90 degrees has a station. Of course, rotation angle of each station is not limited to 90 degrees, and it can be other angles.

While the invention has been described in connection with what are presently considered to be the most practical and preferred embodiments, it is to be understood that the invention is not to be limited to the disclosed embodiments, but on the contrary, is intended to cover various modifications and equivalent arrangements included within the spirit and scope of the invention.

What is claimed is:

1. A separation mechanism, for separating stacked material trays, comprising:

a first frame structure;

a second frame structure with a material area for holding stacked material trays;

a clamping mechanism, comprising a driving motor mounted on the first frame structure, two rotating shafts driven by the driving motor, and a clamping assembly arranged on the rotating shafts, a separation area being formed between the two rotating shafts and located above the material area, the clamping assembly comprising two main clamping portions located on left and right sides of the separation area, each of the main clamping portions comprising a main cam mounted on the respective rotating shaft and a main clamping block following the main cam, the two main cams respectively driving the two main clamping blocks to extend into and withdraw from the separation area, the rotating shafts rotating between an initial station and a clamping station, and the main cams being configured that when the rotating shafts rotate to the initial station, the main cams drive the main clamping blocks to withdraw to release the material tray, and when the rotating shafts rotate to the clamping station, the main cams drive the main clamping blocks to extend to clamp the material tray;

a lifting assembly controlling relative movement of the clamping mechanism and the second frame structure; and

each of the main clamping portions further comprising a guiding element fixed to the first frame structure, and each of the main clamping blocks being movably engaged with the guiding element and moved under the limitation of the guiding element.

2. The separation mechanism according to claim **1**, wherein the clamping mechanism further comprises a holding assembly, which comprises two holding portions arranged respectively on the two rotating shafts and located on left and right sides of the separation area, each of the holding portions comprises a holding cam and a holding block following the holding cam, the two holding cams respectively drive the two holding blocks to extend into and withdraw from the separation area, the rotating shafts rotate between four stations, the holding cams are configured that when the rotating shafts rotate between the initial station and a holding station, the holding cams drive the holding blocks to extend to hold the material tray at the holding station, when the rotating shafts rotate between the holding station and an unloading station, the holding cams drive the holding blocks to withdraw to release the material tray at the unloading station, and when the rotating shafts rotate between the holding station and the clamping station, the main cams drive the main clamping blocks to extend to clamp the material tray before the holding blocks withdraw completely.

3. The separation mechanism according to claim **2**, wherein when the rotating shafts rotate from the unloading station to the initial station, the lifting assembly controls the second frame structure to approach the clamping mechanism, and moves the material tray on the top of the material area to the separation area at the initial station; when the rotating shafts rotate from the holding station to the clamping station, the lifting assembly controls the second frame structure to be away from the clamping mechanism, and the material tray at the top of the material area is separated from the second frame structure at the clamping station.

4. The separation mechanism according to claim **1**, wherein the clamping mechanism further comprises a subordinate clamping assembly, the subordinate clamping assembly comprises a front clamping portion located on the front side of the separation area and a rear clamping portion located on the rear side of the separation area; the front clamping portion comprises a front cam and a front clamping block, the rear clamping portion comprises a rear cam and a rear clamping block; the front cam drives the front clamping block to extend out or withdraw from the front edge of the separation area, and the rear cam drives the rear clamping block to extend out or withdraw from the rear edge of the separation area; and the rotating shafts rotate between four stations, the front cam and the rear cam are configured that when the rotating shafts rotate to the initial station, the front cam and the rear cam respectively drive the front clamping block and the rear clamping block to withdraw to release the material tray, when the rotating shafts rotate between the initial station and the holding station, the front cam drives the front clamping block to extend to the front edge of the separation area, when the rotating shafts rotate between the holding station and the clamping station, the rear cam drives the rear clamping block to extend to the rear edge of the separation area to clamp the material tray, and when the rotating shafts rotate between the clamping station and the unloading station, the front cam and the rear cam drive the front clamping block and the rear clamping block to withdraw to release the material tray.

5. The separation mechanism according to claim **1**, wherein the guiding element is a first guide rail horizontally disposed, and the main clamping block is slidably engaged with the first guide rail.

6. The separation mechanism according to claim **1**, wherein a sliding groove is defined on the main clamping block for the material tray sliding, and the sliding grooves of the two main clamping blocks form a sliding rail for the material tray sliding.

7. A feeding device, comprising a feeding box, a transfer mechanism, and a separation mechanism according to claim **1**, the separation mechanism being installed in the feeding box, the separation area being located at an upper opening of the feeding box, the lifting assembly being connected with the second frame structure and controlling the second frame structure to lift and drive the second frame structure and the clamping mechanism to move relative to each other, a sliding groove is defined on the main clamping block for the material tray sliding, and the sliding grooves of the two main clamping blocks are opposite to form a sliding rail for the material tray sliding.

8. The feeding device according to claim 7, further comprising a stacking assembly comprising a stacking table, a lifting mechanism, and a second guide rail communicating with the sliding rail on the stacking table, the transfer mechanism driving the material tray to move along the sliding rail to the stacking table, and the lifting mechanism lifting the material tray on the stacking table.

* * * * *