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## Description

BACKGROUND OF THE INVENTION

**[0001]** The present invention relates to a transported / sorter and a transporter box, more particularly, to a transporter/sorter for transporting and sorting transport articles as large-size home-distributed envelopes and a transport box to be used with such transporter.

**[0002]** Up to date, documents, magazines, books, CD cases etc., are sent as home-distributed mails and post mails.

**[0003]** The documents, magazines, etc. that are sent are accommodated in large vinyl or paper envelopes or cardboard or thick paper cases for home distribution or post mails. Sometimes, magazines or the like are sent without being accommodated in envelopes or cases but by merely bound with strips or in the bear state.

**[0004]** Large-size envelopes and cases as noted above (including post cards and small envelopes) are sorted by special transporters/sorters.

**[0005]** A prior art transporter/sorter (for transporting and sorting post cards or small envelopes) will now be described with reference to drawings.

**[0006]** Figs. 5 (a) and 5 (b) are schematic views showing such a prior art transporter/sorter, Fig. 5 (a) being a plan view and Fig. 5 (b) being a front view. Fig. 6 is a schematic enlarged view showing a part E in Fig. 5 (a) Fig. 7 is a schematic enlarged-scale view taken from F in Fig. 6.

**[0007]** As shown in Figs. 5 (a) and 5 (b) to 24, the prior art transporter/sorter 500 comprises a frame 510, a guide rail 550 provided inside the frame 510 and in the form of an endless loop having straight and curved portions, a plurality of transport wagons 530 supported on the guide rail 550 for traveling in circulation along the endless loop path, and transport boxes 520 each suspended from each transport wagon 530.

**[0008]** The transport wagons 530 are coupled for revolution via joints 5131 inserted in the perpendicular direction (see Fig. 23).

**[0009]** The transport wagons 530 and the joints 5131 constitute a chain conveyor 560. With rotation of sprockets (not shown) that are provided on the chain conveyor 560, the transport wagons 530 are caused to undergo excursion inside the guide rail 550.

**[0010]** The transport boxes 520 have a shape of a substantially rectangular box. Each transport box 520 is provided, on a side face of the outer side of the guide rail 550, with an accommodating port (not shown), through which a transport article 5101 is fed (i.e., thrown) and, on the bottom, with a rotary bottom lid (not shown into) for discharging the transport article 5101.

**[0011]** The transport boxes 520 are hung from alternate ones of the coupled transport wagons 530 (see Fig. 7). Each transport box 520 is supported such that, in top view, gravitational center is found substantially right underneath the guide rail 550. More specifically, in the top view, the transport box 520 is supported such that its outer half is found on the outer side of the guide rail 550 while its lower half is found on the inner side of the guide rail 550 (see Fig. 6).

**[0012]** The frame 510 includes a plurality of section frames 5111 and a feeder frame 5112 (see Fig. 5).

**[0013]** The section frames 5111 each has a plurality of stackers 5113, in which transport articles 5101 discharged from the transport boxes 520 are stacked. The feeder frame 5112 has a feeder 513 for feeding transport articles 5101 via the belt to the transport box 520.

**[0014]** Generally, the stackers 5113 and the feeder 513 are disposed in a straight transport part of the transport box 520.

**[0015]** The operation of the transporter/sorter 500 will now be described.

**[0016]** Transport articles 5101 (i.e. postal matter, mainly post cards and small envelopes) are transported one by one from the feeder frame 5112 via the belt 514 to the feeder 513. Then, each transport article 5101 is thrown into a predetermined transport box 520 by the feeder 513.

**[0017]** The transport boxes 520 are transported at a constant speed by a drive means (not shown) for moving the chain conveyor 560. In the transporter/sorter 500, as shown in Fig. 6, the transport boxes 520 are spaced apart at a constant pitch (pitch L3 = pitch L4). That is, the pitch of the transport boxes 520 are set to L4, at which the inner halves of adjacent transport boxes 520 do not interfere (i.e., are not in contact) with one another in the curved portions of the guide rail 550.

**[0018]** The transport articles 5101 which are transported in each transport box 520 are discharged into predetermined stackers 5113 in the section frames 5111 for different destinations, respectively. In other words, the transporter/sorter 500 sorts out the transport articles 5101 during transport thereof for different destinations, respectively.

**[0019]** Another example of a conventional transporter/sorter will be described with reference to Figs. 8 - 10.

**[0020]** Fig. 8a is a schematic plan view of a conventional transporter/sorter and Fig. 8b is a schematic front view of such transporter/sorter.

**[0021]** In Figs. 8a and 8, the prior art transporter / sorter 500 comprises a frame 510, a guide rail 550 of an endless loop having straight portions and curved portions and also provided in the frame 5110, and a plurality of transport boxes 520 depending from the guide rail 550 so as to travel in circulation along the endless loop path.

**[0022]** The frame 5110 comprises a plurality of section frames 5111 and four feeder frames 5112. The section frames 5111 are provided with a plurality of stackers 5113 for stacking transport articles 5101 discharged from the transport boxes 520. On the other hand, the feeder frames 5112 comprise feeder frames 512 for feeding stacked transport articles 5101 one by one, belts 514 for transporting the fed transport articles 5101, and feeding means 513 for transporting the fed transport articles 5101

to the transport boxes 520.

**[0023]** It is to be noted that the stackers 5113 and the feeding means 513 are generally disposed at the straight transport portions for the transport boxes 520. The transport articles 5101 may be post cards, documents, magazines , books, CD cases, etc., but not limited thereto.

**[0024]** Fig. 9a is a schematic front view of the prior art transport box, while Fig. 9b is a schematic side view of the prior art transport box as seen from the outside thereof.

**[0025]** In Figs. 9a and 9b, the transport box 520 is a generally rectangular box and comprises four accommodating chambers 5121 divided by partitioning plates 5122 at an equal spacing. As best shown in Fig. 9b, the transport box 520 is a parallelogram that is projecting in the transport direction at the top as seen from the side. With this arrangement, the transport articles 5101 can be discharged smoothly.

**[0026]** Additionally, the transport box 520 is depending from the guide rail 550 by way of inter-coupled transport wagons (not shown). The transport boxes 520 are supported onto the guide rail 550 in such a manner that the center of gravity of each transport box 520 is immediately below the guide rail 550 as seen from the top.

**[0027]** Each of the transport boxes 520 is formed with a feeding port 5123 on the side face in the outer direction through which the transport article may be thrown.

**[0028]** Each of the accommodating chambers 5121 is made to have a constant width W in the transport direction over the entire area as seen from the front. Accordingly, the width in the transport direction of the feeding space 5124 which is used when the transport articles 5101 are fed is also W (constant) over the entire area as seen from the front.

**[0029]** The transport boxes 520 are formed with a revolving bottom lid 518 at the bottom of each accommodating chamber 5121 as discharging means for the transport articles 5101.

**[0030]** The bottom lid 518 is pivotally supported at both ends in such a manner that the bottom lid 518 is in the open state (see the solid arrow in Fig. 9b) by spring bias of a coil spring 581. On the other hand, the bottom lid 518 is kept in the closed state by engagement of a notch 582 with an engaging plate 583 when it is closed.

**[0031]** Also, the engagement plate 583 is coupled to an abutment plate 584 which is pivotally supported in a biased in the closed state (see the dotted arrow in Fig. 9b) by an elastic member such as a coil spring or the like (not shown).

**[0032]** The bottom lid 518 is arranged so that, when the transport box 520 is transported over a predetermined stacker 5113, a pin 586 of a solenoid 585 (see Fig. 9a) disposed in the inward orientation projects for a short time, thereby allowing the abutment plate 584 to revolve. Such revolution also allows the engagement plate 583 to revolve, thereby opening the biased bottom lid 518 and maintaining such state.

**[0033]** Moreover, when the transport box 520 passes the last stacker 5113, the bottom lid 518 in the open state is in contact with a bottom plate (not shown) disposed at the lower portion of the transport box 520, thereby revolving the bottom lid 518 in the closing direction. When the bottom lid 518 is closed, the notch 582 engages with the engagement plate 583 and the bottom lid 518 remains in the closed state.

**[0034]** It is to be noted, however, that the discharging means is not limited to the above configuration comprising the bottom lid 518.

**[0035]** As shown in Fig. 10, the feeding means 513 comprises, for example, two belts 5132, 5133 which run over a plurality of rollers 5134 for transporting the transport articles 101 therebetween, a roller 5135 provided at the end portion in the transport direction, and swinging means (not shown) for swinging the feeding means 513 in response to the transport speed and timing of the transport box 520. With this arrangement, since the feeding means 513 swings the transport box 520 in harmonize with the transport speed and timing of the transport box 520, it is possible to extend the feeding time (from the start of feeding to the completion of feeding).

**[0036]** Now, the operation of the transporter/sorter 500 as sown in Figs. 8 - 10 will be described.

**[0037]** The transporter/sorter 500 transports the transport articles 5101 which are fed by the belts 514 of the feeder 512 one by one to the feeding means 513. Then, the feeding means 513 feeds the transport particles 5101 to the predetermined accommodating chamber 5121. It is to be noted that, in general, the most upstream (or a first) feeding means 513 feeds the transport articles 5101 to the leading (or a first) accommodating chamber 5121 in the transport direction. Then, the subsequently downstream (second, third and fourth) feeding means 513 feed the transport articles 5101 to the sequential (second, third and fourth) accommodating chambers 5121.

**[0038]** Fig. 10 is cross section views seen from the top for describing the feeding operation of the prior art feeding means, wherein Fig. 10 (a) is a schematic view when the feeding is started, Fig. 10 (b) is a schematic view on the half way of feeding operation, Fig. 10 (c) is a schematic view when the feeding operation has been completed and Fig. 10 (d) is a schematic when it is in preparation for feeding.

**[0039]** In Fig. 10 (a), the feeding means 513 swings by the swinging means in such a manner that the velocity component at the end portion where the transport articles 5101 are pushed out is substantially equal to the transport speed of the transport box 520. And the transport articles 5101 are fed by the two belts 5132, 5133. It is to be noted that the feeding start time is when a leading end of a transport article 5101 reaches the feeding port 5123.

**[0040]** Then, in Fig. 10 (b), the feeding means 513 continues to swing, thereby feeding the transport article 5101 into the feeding space 5124 in the accommodating chamber 5121. As shown in Fig. 10 (c), the feeding means 513 continues to swing and feeding until the tail end of the

transport article 101 reaches the feeding port 5123. The completion time of feeding is the time when the tail end of the transport article 5101 has reached the (the last) feeding port 5123.

**[0041]** Upon completion of the feeding, the feeding means 513 decreases the swinging speed and stops. Subsequently, the feeding means 513 swings in the opposite (returning) direction and stops to resume the ready condition in preparation for the next feeding as shown in Fig. 10 (d).

**[0042]** It is to be noted that the transport articles 5101 are thrown into the feeding spaces 5124 from the feeding ports 5123 in substantially horizontal direction and fall downward by colliding with inner side plates 5125. And the fallen transport articles 5101 are clamped by the outer side plate 5126 (see Fig. 9b) so that they do not jump out of the feeding ports 5123.

**[0043]** Then, the transporter/sorter 500 transport the transport boxes 520 in which the transport articles 5101 are fed along the guide rail 550 to the section frames 5111 by driving means (not shown). And the transporter/sorter 500 opens the bottom lids 518 for discharging the transport articles 5101 into the respective stackers 5113 depending on their destinations. That is, the transporter/sorter 500 can classify the transport articles 5101 to their destinations while being transported.

**[0044]** Incidentally, let the width of each accommodating chamber 5121 in the transport direction be W and the thickness of the transport article 5101 in the transport direction be t as shown in Fig. 9b, the gap $\Delta$ of the feeding spaces 5124 in the transport direction is $\Delta$ = W-t (mm).

**[0045]** Transport density of the transport boxes 520 is given by t/W (%) on the assumption that the thickness of the partitioning plates 5122 is negligible small.

**[0046]** Furthermore, the feeding time required for stably feeding the transport articles 5101 is proportional to $\Delta$ and counter proportional to the transport speed v of the transport boxes 520.

**[0047]** As understood from the above relationship, if the transport density is increased in order to improve the transport capacity of the transport boxes 520, $\Delta$ decreases and thus reducing the feeding time, thereby decreasing feeding stability. Similarly, if the transport speed v is increased in order to improve the processing capacity of the transporter/sorter 500, A decreases and thus reducing the feeding time, thereby decreasing feeding stability.

**[0048]** On the other hand, if the feeding speed of the feeding means 513 is made constant, since the feeding time increases as the length of the transport article 5101 in the feeding direction becomes longer, it is necessary to increase the gap $\Delta$ in the transport direction or decrease the transport speed v.

**[0049]** Since the transporter/sorter 500 can improve processing capacity by increasing the transport density, various techniques have been developed. Japanese patent publication no. 2003-237926 discloses techniques of a transporter/sorter of variable transport box pitch type.

**[0050]** In this transporter/sorter, a transport box pitch varying mechanism for varying the pitch of transport boxes is provided at the boundaries between straight and curved portions of an endless loop path. The density of mounting of transport boxes in the straight portions thus can be increased, and the transfer speed in the straight portions can be held at a minimum necessary value. With this arrangement, without reduction of the transport article processing capacity, it is possible to ensure stable operations of feeding and discharging transport articles.

**[0051]** Although the variable pitch type transporter/sorter could increase the processing capacity by realizing higher transport density at the straight portions, the market demands are to provide further improvement on the processing capacity. However, in the high density transport, the adjacent transport boxes are almost in contact with one another. In order to further increase the processing capacity of the transporter/sorter, it is required to reduce the gap $\Delta$ of the accommodating chambers in the transport direction or to increase the transport speed v of the transport boxes.

**[0052]** However, the prior art transporters/sorters as described hereinabove have the following problems.

**[0053]** In the prior art transporter/sorter 500 shown in Figs. 5 (a), 5 (b) and 6, the transport wagons 530 undergoing excursion along the endless loop path hang the transport boxes 520 at the top center part thereof at a constant interval for the transport of the transport boxes 520.

While the minimum pitch L4 is set, at which adjacent transport boxes 520 do not interfere with one another in the curved portions of the endless loop path of the transporter/sorter 500, in the straight portions the pitch L3 of the transport boxes 520 includes a large gap. This means a sacrifice given to the straight portions with respect to the efficiency of mounting the transport boxes 520, i.e., the transport density. That is, it is impossible to improve the processing capacity of the transport articles 5101 or ensure stable processing operation.

**[0054]** Also, in the transporter/sorter 500 the number of transport articles 5101 processed per unit time depends on the transfer speed of the transport wagons 530. That is, the processing number can be increased depending on the transport speed. However, the transporter/sorter 500 has a drawback that increasing the transport speed gives rise to unstable operations of feeding (i.e., throwing) and discharging transport articles 5101, executed with respect to the transport boxes 520 being transferred, thus leading to reliability deterioration in the operation of processing the transport articles 5101.

**[0055]** As a further drawback of the transporter/sorter 500, reducing the transfer speed to make stable the operation of feeding and discharging the transport articles 5101, reduces efficiency of mounting the transport boxes 520 in the straight portions, thus reducing the unit time process capacity of the transporter/sorter 500.

**[0056]** The transporter/sorter as shown in Figs. 8 - 10 has a drawback that the transport articles tend to contact with the partitioning plates of the accommodating cham-

bers at the opposite sides to the transport direction before completion of feeding of the transport articles if the gap Δ in the transport direction between the adjacent accommodating chambers in the transport box is reduced or if the transport speed v of the transport boxes of the transporter/sorter is increased, thereby causing unstable feeding or failure of feeding.

**[0057]** Particularly, if the transport articles become larger in the feeding direction, the feeding time becomes longer. The extended feeding time is a bottleneck for improving the processing capacity of the transporter/sorter.

**[0058]** On the other hand, the transporter/sorter of variable transport box pitch type as disclosed in the above patent publication has a problem that the transport box pitch varying mechanism is complicated in arrangement and control, and therefore it is impossible to reduce, for instance, the cost of manufacture.

EP 0 608 161A discloses a transporter/sorter according to the preamble of claim 1.

Similar devices are known from US 2,689,657 A and US 6,595,346 B1.

## SUMMARY OF THE INVENTION

**[0059]** It is therefore an object of the present invention to solve the above problems and to provide a transporter/sorter, which is simple in arrangement and permits transport articles processing capacity improvement and process operation stabilization.

This object is achieved by a transporter/sorter as claimed in claim 1; the dependent claims are related to further developments of the invention.

**[0060]** According to an aspect of the present invention, there is provided a transporter/sorter comprising a plurality of transport boxes undergoing circulation along an endless loop path and feeding units for feeding transport articles to the transport boxes, wherein each of the feeding units comprises: a feeding means for feeding transport articles to each transport box, and a parallel-driving means for driving the feeding means in parallel with the transport box.

**[0061]** With this arrangement, since the transport time can be extended, it is possible to ensure stable feeding operation, reduce the transport direction gap Δ of the accommodating chamber in the transport box and increase the transport speed v of the transport boxes, thereby improving the process capacity.

**[0062]** According to another aspect of the present invention, there is provided the above transporter/sorter, wherein the feeding means comprises: a receiving space for receiving the transport articles while being driven by parallel-driving; and a transport belt provided between a receiving side and a discharging side of the receiving space and transporting the received transport articles to the discharging port side.

**[0063]** With this arrangement, the feeding means can reliably receive transport articles even by being driven by the parallel-driving.

**[0064]** According to another aspect of the present invention, there is provided the above transporter/sorter, wherein the feeding means is provided with a discharging belt for discharging the transport articles.

**[0065]** With this arrangement, it is possible to reliably discharge transport articles without causing damage thereto.

**[0066]** According to a further aspect of the present invention, there is provided the above transporter/sorter, wherein the feeding means comprises: a receiving space for receiving the transport articles while being driven by parallel-driving; and a transporting/discharging belt provided between a receiving port side and a discharging port side of the receiving space and serving to transport the received transport articles to the discharging port side and discharge the transport articles.

**[0067]** With this arrangement, it is possible to permit common use of the belt, thereby reducing the cost of manufacture.

**[0068]** According to a still further aspect of the present invention, there is provided the above transporter/ sorter, wherein the feeding means comprises: a parallel-driving guide forming an endless loop path; and a plurality of parallel-driving wagons supported for movement on the parallel-driving guide rail, and undergoing excursion along the endless loop path and supporting the feeding means in an inter- coupled state.

**[0069]** With this arrangement, the feeding means can be continuously driven by parallel driving along the endless loop path, thereby increasing the parallel-driving speed and readily controlling the parallel-driving speed and timing.

**[0070]** According to a further aspect of the present invention, there is provided the above transporter/sorter, wherein the parallel-driving guide rail has a parallel-driving feeding area constituted by a straight portion.

**[0071]** With this arrangement, it is possible to simplify the arrangement of the parallel-driving means and reduce the cost of manufacture.

**[0072]** According to a further aspect of the present invention, there is provided the above transporter/sorter; wherein the discharging belt or the discharging port side thereof is revolved in the parallel-driving direction upon reception of an external force.

**[0073]** With this arrangement, even in the case when the feeding means passes through the parallel-driving feeding area with the transport article found to be on both the transport box and the feeding means, it is possible to prevent undesired damage caused to the transport article.

**[0074]** The transporter/sorter according to the invention permits, by feeding the transport article while driving the feeding means in parallel with the transport box, to ensure stable transport article feeding operation, increase the transport speed and increase the transport density, thereby improving the process capacity.

**[0075]** Other objects and features of the present invention will be clarified from the following description with

reference to attached drawings.

## BRIEF DESCRIPTION OF THE DRAWINGS

**[0076]**

Fig. 1 is a schematic front view of an embodiment of the transporter/sorter according to the present invention;
Fig. 2a is an enlarged schematic plan view showing an important part of the feeding member in the transporter/sorter as shown in Fig. 1;
Fig. 2b is a schematic cross section view taken along line A-A in Fig. 2a;
Fig. 2c is an enlarged schematic view as seen from the direction B in Fig. 2a;
Fig. 3 is schematic views of the feeding member in Fig. 2 for describing feeding steps of transport articles;
Fig. 4 is a schematic view of feeding means as an application of the transporter/sorter in Fig. 2;
Figs. 5 (a) and 5 (b) are schematic views showing a prior art transporter/sorter, Fig. 5 (a) being a plan view and Fig. 5 (b) being a front view;
Fig. 6 is a schematic enlarged view showing a part E in Fig. 5 (a);
Fig. 7 is a schematic enlarged view taken from a direction F in Fig. 6;
Fig. 8a is a schematic plan view of another prior art transporter/sorter;
Fig. 8b is a schematic front view of the transporter/sorter in Fig. 25a;
Fig. 9a is a schematic front view of the transport box in Fig. 8;
Fig. 9b is a schematic side view of the transport box in Fig. 8 as seen from outside; and
Fig. 10 is cross section views of the feeding means as seen from the top for describing the feeding stops, wherein (a) is a schematic view at the start of feeding, (b) is a schematic view on the half way of feeding, (c) is a schematic view when feeding has been completed, and (d) is a schematic in preparation for next feeding.

## PREFERRED EMBODIMENTS OF THE INVENTION

**[0077]** Now, an embodiment of the transporter/sorter according to the present invention will be described with reference to Figs. 1 - 4.

**[0078]** Fig. 1 is a schematic front view showing the embodiment of the transporter/sorter according to the invention.

**[0079]** Referring to Fig. 1, the transporter/sorter 221 is different from the prior art transporter/sorter 500 in that it comprises feeding units 222 instead of the feeding means 513. The other constituent elements are substantially the same as in the prior art transporter/sorter 500.

**[0080]** Thus, in Fig. 1, elements like those in Fig. 5 are designated by like reference numerals, and their detailed description is not given herein.

**[0081]** Fig. 2a is an enlarged schematic front view showing essential parts of feeding units in the second embodiment of the transporter/sorter according to the invention . Fig. 2b is an enlarged schematic cross section view taken along line A-A in Fig. 2a. Fig. 2c is an enlarged schematic view taken in direction B in Fig. 2a.

**[0082]** Referring to Figs. 2a - 2c, each feeding unit 222 comprises a feeding means 223 for feeding transport articles 2101 to a transport box 220 and a wagon 242 for parallel driving. A parallel driving means 224 is provided for driving the feeding means 223 in parallel with the transport box 220.

**[0083]** In Fig. 2a, a front side guide rail 241 for parallel driving is omitted for better understanding of the arrangement of the parallel running wagons 242. Also, in Fig. 2c, a parallel driving side guide plate 233 is shown by dashed lines to facilitate the understanding.

**[0084]** The feeding means 223 comprises a base member 231, a counter-parallel-driving direction side guide plate 232, a parallel-driving direction side guide plate 233, a belt 234 for transport and discharging, and a roller 235.

**[0085]** The base plate 231 is rectangular, and its bottom surface is supported by a coupling member 2426 on the parallel-driving wagon 242 of the coupling member 2426. The lateral width of the base plate 231 is substantially the same length as the pitch of the transport boxes 220.

**[0086]** The base plate 231 in this embodiment has a smoothly finished surface to facilitate the slipping of transport articles 2101. This arrangement, however, is by no means limitative. For example, a belt conveyor (not shown) may be provided for moving transport articles 2101 to the discharging port side.

**[0087]** The counter-parallel-driving direction side guide plate 232 is rectangular, and is provided at the parallel-driving direction side end of the base plate 231 in a state that its top is inclined to the parallel-driving direction side. The inclination angle is substantially the same as that of the feeding port 2123 of the transports box 220. The guide plate 232 has such a length that it does not touch the roller 235 lest the movement thereof should be prevented.

**[0088]** In the parallel-driving direction side guide plate 232, the parallel-driving direction side surface serves as a guide surface, and it guides a transport article 2101 fed by the immediately preceding feeding means 223 from the counter-parallel-driving direction side.

**[0089]** The parallel-driving direction side guide plate 233 has a triangular guide plate 2331 for transport and a guide plate 2332 for discharging. The guide plate 2331 for transport extends from the top of a receiving port side transport/discharging belt 234 to the parallel-driving direction side. The guide plate 2331 is mounted via an arm (not shown) on the base plate 231 in a state that its top is inclined to the parallel driving direction side. The guide

plate 2332 for discharging is found on the top and parallel-driving direction side of the belt 234 for discharging. The guide plate 2332 is mounted via a coupling member (not shown) on a coupling arm 2346 such that its top is inclined to the parallel-driving side at substantially the same inclination angle as that of the feeding port 2123. Thus, the guide plate 2332 for discharging is revolved together with the coupling arm 2346.

**[0090]** With the provision such parallel-driving side guide plate 233, it is possible to reliably receive and discharge transport articles 2101.

**[0091]** The transport/discharging belt 234 has a drive roller 2341, a driven roller 2342, an intermediate roller 2343, a biasing roller 2344, a belt 2345 and a coupling arm 2346.

**[0092]** The drive roller 2341 is supported for revolution at the end of the base plate 231 on the parallel-driving direction side and the receiving port side. The drive roller 2341 is rotated such that a pinion (not shown) provided on its lower part moves a rack (not shown) provided on top of the guide rail 241 for parallel running is moved in the parallel-driving direction.

**[0093]** The driven roller 2342 is supported for rotation at the end of the base plate 231 on the counter-parallel-driving direction side and the discharging port side. The driven roller 2342 is supported for revolution via a coupling arm 2346 on the intermediate roller 2343 in a state that it is biased in the clockwise direction. With this arrangement, it is possible to discharge transport articles 2101 having different thicknesses.

**[0094]** Preferably, although not shown, such an arrangement may be made that when the transport/discharging belt 234, found between the driven roller 2342 and the intermediate roller 2343, receives a predetermined external force directed to the parallel driving direction side, the belt 234 further undergoes revolution to the parallel driving direction side. With this arrangement, even in such case as when the feeding fails to be made normally, for instance when the feeding means 223 passes through the parallel-driving feeding area 244 in such a state that the transport article 2101 is found in both the transport box 220 and the feeding means 223, it is possible to prevent the undesired breakage of the transport article 2101.

**[0095]** The protective function of protecting the transport article 2101 is not limited to the above arrangement; for instance such an arrangement is possible as the roller 235 is revolved toward the counter-parallel-driving direction side by receiving a predetermined external force directed to the counter-parallel-driving direction side.

**[0096]** The intermediate roller 2343 is supported for revolution on substantially the center portion of the base plate 231.

**[0097]** The biasing roller 2344 is provided in the vicinity of the intermediate roller 2343 in a state that it is biased in the counter-parallel-driving direction side, and pushes the belt 2345 from the counter-parallel-driving direction side to exert a predetermined tension to the belt 2345.

**[0098]** The belt 2345 is passed round the drive and driven rollers 2341 and 2342, and provides a common function as a transport belt and a discharging belt. With the common use of the belt 2345, it is possible to reduce the cost of manufacture.

**[0099]** The transport/discharging belt 234 is provided such that its top is inclined to the parallel driving direction side at substantially the same angle as that of the feeding port 2123.

**[0100]** The roller 235 is supported for revolution at the end of the base member 231 on the parallel-driving direction side and the discharging port side such that its top is inclined to the parallel driving direction side at substantially the same angle as that of the feeding port 2123.

**[0101]** In this example, the feeding means 223 forms a receiving space 236 defined substantially by the base plate 231, the transport/discharging belt 234, the parallel driving side guide plate 233 and the counter-parallel-driving direction side guide plate 232.

**[0102]** The feeding means 223 of the above arrangement can, even in the state of parallel driving, reliably receive the transport article 2101 from the belt 214 and reliably discharge the transport article 2101 without breakage.

**[0103]** The parallel-driving means 224 comprises the guide rail 241 for parallel driving and a screw 243 as driving means for moving the wagon 242 for parallel driving and the wagon 242 for discharging.

**[0104]** The guide rail 241 for parallel driving is constituted by a pair of endless loop rails formed with grooves 2411 facing each other, into which the roller bearing 2422 is inserted horizontally. The guide rail 241 is supported via a support member (not shown) on a feeding part frame 2112 in such a state that it forms a gap, into which the roller bearings 2423 and 2424 are inserted in the vertical direction.

**[0105]** The parallel driving guide rail 241 forms an elliptical path in the front view, and its area corresponding to an upper straight part of the ellipse is made to be a parallel-driving feeding area 244. By setting the length of the parallel-driving feeding area 244, it is possible to adjust the feeding time and thus cope with an increase of the transport speed of the transport box 220. Also, with the elliptical parallel-driving guide rail 241 it is possible to simplify the arrangement of the parallel driving means 224 and reduce the cost of manufacture.

**[0106]** The wagon 242 for parallel driving comprises a wagon body 2421 in the form of a curved angular bar, a pair of roller bearings 2422 projecting horizontally from the counter-parallel-driving direction side end of the wagon body 2421, a roller bearing 2423 projecting upward from the counter-parallel-driving side end of the wagon body 2421, two-stage roller bearings 2424 and 2425 projecting downward from the center of the wagon body 2421, and a coupling member 2426 projecting upward from the center of the wagon body 2421. In the wagons 242 for parallel driving, the pairs of roller bearings 2422 couple together the wagon bodies 2421 for revolution.

The lower stage roller bearings 2425 are received in a groove of a screw 243.

**[0107]** The wagons 242 for parallel driving are restricted in position by pairs of roller bearings 2422 and roller bearings 2423 and 2424, and can be moved only in the parallel driving direction along the parallel-driving guide rail 241.

**[0108]** The screw 243 as driving means is rotated by a motor and a control unit (not shown), thus causing excursion of the roller bearings 2425 inserted into the groove in a screw 243 in the parallel-driving direction. The screw 243 is controlled by the control unit in the rotation speed and timing. In this way, in the parallel driving feeding areas 244 the feeding means 223 is driven to run along with the transport boxes 220 in synchronism with the transport speed and timing of the transport boxes 220.

**[0109]** Thus, the parallel-driving means 224 can continuously drive together a plurality of feeding means 223, as well as increasing the parallel driving speed and readily control the parallel-driving speed and timing.

**[0110]** Now, the operation of the feeder 221 of the above arrangement will now be described with reference to Figs. 3(a) - 3(i).

**[0111]** Figs. 3 (a) - 3 (i) are schematic views showing an essential part for describing a state, in which a feeding unit in the embodiment of the transporter/sorter according to the invention feeds transport articles.

**[0112]** The transporter/sorter 221 is different from the prior art transporter/sorter 500 in that, the feeding units 222 are provided in lieu of the feeding means 513. Thus, operations irrelevant to the feeding units 222 are substantially the same as the operations in the transporter/sorter 500.

**[0113]** In Fig. 3(a), in the transporter/sorter 221 the transport box 220 is transported at a predetermined transport speed. The feeding unit 222 is also driving the feeding means 223 in parallel with the transport box 220 at the timing of the feed of the discharged transport articles 2101 to a predetermined accommodating chamber 2123.

**[0114]** The feeding means 223 is in a state that the transport/discharging belt 234 is being rotated and that it is ready for receiving the transport article 2101 transported by the belt 214. This position is the start position in the parallel-driving feeding area 244.

**[0115]** Then, in Fig. 3 (b), the leading end of the transport article 2101 transported by the transport/discharging belt 214 enters a receiving space 236 in the feeding means 223. Then, in Fig. 3(c), the transport article 2101 further proceeds into the receiving space 236 in the feeding means 223. At this time, even when the leading end of the transport article 2101 touches the belt 214, owing to the rotating state of the transport/discharging belt 234 it is possible to prevent undesired damage to the transport article 2101.

**[0116]** Then, in Fig. 3(d), the trailing end of the transport article 2101 is being transported, and the leading end of the transport article 2101 is brought into contact with the transport/discharging belt 234 and transported to the discharging port side.

**[0117]** Although not shown, even when the trailing end of the transport article 2101 is spaced apart from the belt 214, the transport article 2101 is transported to the discharging port side by the momentum received from the belt 214 and the transport/discharging belt 234. At this time, the transport article 2101 is guided by the parallel-driving direction guide member 233, and a part of the transport article 2101 is brought into contact with the transport/discharging belt 234. Thus, the transport article 2101 is reliably transported to the discharging port side.

**[0118]** Then, in Fig. 3 (e), when the transport article 2101 is clamped between the counter-parallel-driving direction side guide member 232 and the transport/discharging belt 234, the coupling arm 2346 is revolved in the counterclockwise direction according to the thickness of the transport article 2101. Subsequently, in Figs. 3 (f) - 13(h), the feeding means 223 continues to rotate even in the revolving state of the coupling arm 2346, thus moving the transport article 2101 at the moving speed of the transport/discharging belt 234 to a predetermined accommodating chamber 2123 in the transport box 220. Since at this time the feeding means 223 is being driven in parallel with the transport box 220 as described above, it can stably feed the transport article 2101.

**[0119]** Then, in Fig. 3(i), when the trailing end of the transport article 2101 is separated from the transport/discharging belt 234, the coupling arm 2346 of the feeding means 223 is revolved in the clockwise direction. Also, the transport article 2101 perfectly enters the accommodating chamber 2123 by the momentum received from the transport/discharging belt 234, thus completing the operation of feeding one transport article 2101. The feeding operation is completed at a position in the parallel-driving feeding area 244, and thus the feeding operation can be performed safely and reliably.

**[0120]** As shown above, in the transporter/sorter 221 the feeding means 223 of the feeding unit 222 feeds the transport article 2101 while being driven in parallel with the transport box 220, it is possible to achieve reliable and stable feeding as well as increase the transport density.

**[0121]** Furthermore, since the feeing of the transport article 2101 is executed in the relatively stationary state of the transport box 220 and the feeding means 223, it is possible to increase the transport speed of the transport box 220.

**[0122]** In other words, the transporter/sorter 221 can stabilize the feeding operation and greatly improve the process capacity.

**[0123]** While the preferred embodiment of the feeding unit according to the invention has been described, it is by no means limited to the above embodiment, and various changes and modifications may of course be made without departing from the scope of the invention.

**[0124]** For example, in the transporter/sorter 221 the

feeding means 223 transports the received transport article 2101 to the discharging port side by utilizing the transport/discharging belt 234 between the receiving port side and the discharging port side of the receiving space 236, and discharges the transport article 2101 by using the transport/discharging belt 234 and the roller 235. It is to be noted that this arrangement is by no means limitative.

**[0125]** In a feeding means 223a as shown in Fig. 4, in lieu of the roller 235 a discharging belt 235a comprising a pair of roller 2351 and a belt 2352, is provided on the counter-together-driving side and the discharging port side of the base member 231a, and in lieu of the counter-parallel-driving direction side guide member 232 a counter-parallel-driving side guide member 232a is provided on the counter-parallel-driving direction side. With this arrangement, the belt 2352 is rotated by the transport/discharging belt 234. Thus, it is possible to improve the performance of transporting the transport article 2101 to the discharging port side.

**[0126]** While the transporter/sorter according to the invention is particularly suited to such large take-out articles as documents, magazines, books, CD cases, etc., large take-out articles are by no means limitative, and the invention is suitably applicable as well to small take-out articles such as post cards and small envelopes.

## Claims

1. A transporter/sorter comprising a plurality of transport boxes (220) undergoing circulation along an endless loop path and feeding (222) feeding transport articles (2101) to the transport boxes, wherein each of the feeding units comprises:

   a feeding means (223) for feeding transport articles to each transport box, and
   a wagon (242) for driving the feeding for driving the feeding means in parallel with the transport box, the feeding means comprising
   a receiving space for receiving the transport articles while being driven by parallel-driving; **characterized by**
   a transport belt (234) provided between a receiving port side and a discharging port side of the receiving space and transporting the received transport articles to the discharging port side.

2. The transporter/sorter according to claims 1, wherein the feeding means is provided with a discharging belt for discharging the transport articles.

3. The transporter/sorter according to claim 1, wherein the transport belt (234) is provided between the receiving port side and the discharging port side of the receiving space and serves to transport the received transport articles to the discharging port side and discharge the transport articles.

4. The transporter/sorter according to either one of claims 1 - 3 and further comprising
   a parallel-driving guide rail (241) forming an endless loop path;
   the parallel-driving wagons (242) being supported for movement on the parallel-driving guide rail (241), and undergoing excursion along the endless loop path and supporting the feeding means in an inter-coupled state.

5. The transporter/sorter according to claim 4, wherein the parallel-driving guide rail has a parallel-driving feeding area constituted by a straight portion.

6. The transporter/sorter according to claims 2, or 3, wherein the discharging belt or the discharging port side thereof is revolved in the parallel-driving direction upon reception of an external force.

## Patentansprüche

1. Transportier-/Sortiervorrichtung mit einer Anzahl von Transportbehältern (220), die einem Umlauf entlang eines Endlosschleifenweges durchlaufen, und Fördereinheiten (222) zum Fördern von Transportartikeln (2101) zu den Transportbehältnissen, wobei jede der Fördereinheiten aufweist:

   eine Fördereinrichtung (223) zum Fördern von Transportartikeln zu jedem Transportbehältnis und
   einen Wagen (242) zum Antreiben der Fördereinrichtung parallel zu dem Transportbehältnis, wobei die Fördereinrichtung aufweist
   einen Aufnahmeraum zum Aufnehmen der Transportartikel, während sie durch Parallelantrieb getrieben werden, **gekennzeichnet durch**
   einen Transportgurt (234), der zwischen einer Aufnahmeöffnungsseite und einer Abgabeöffnungsseite des Aufnahmeraumes angeordnet ist und die aufgenommenen Transportartikel zur Abgabeöffnungsseite transportiert.

2. Transportier-/Sortiervorrichtung nach Anspruch 1, wobei die Fördereinrichtung mit einem Abgabegurt zum Abgeben der Transportartikel versehen ist.

3. Transportier-/Sortiervorrichtung nach Anspruch 1, wobei der Transportgurt (234) zwischen der AufnahmeöfFnungsseite und der Abgabeöffnungsseite des Aufnahmeraumes angeordnet ist und dazu dient, die aufgenommenen Transportartikel zur Abgabeöffnungsseite zu transportieren und die Transportartikel abzugeben.

4. Transportier-/Sortiervorrichtung nach einem der Ansprüche 1 bis 3 und mit ferner
einer Parallelantriebsführungsschiene (241), die einen Endlosschleifenweg bildet,
wobei die parallel betriebenen Wagen (242) für eine Bewegung auf der Parallelantriebsführungsschiene (241) getragen werden und einen Umlauf entlang des Endlosschleifenweges durchführen und die Fördereinrichtung in einem Zwischenkoppelzustand tragen.

5. Transportier-/Sortiervorrichtung nach Anspruch 4, wobei die Parallelantriebsführungsschiene einen Parallelantriebsförderbereich aufweist, der durch einen geraden Abschnitt gebildet ist.

6. Transportier-/Sortiervorrichtung nach Anspruch 2 oder 3, wobei der Abgabegurt oder seine Abgabeöffnungsseite in der Parallelantriebsrichtung bei Empfang einer externen Kraft gedreht wird.

**Revendications**

1. Dispositif de transport/triage comprenant une pluralité de boîtiers de transport (220) circulant le long d'un trajet en boucle sans fin et des unités d'alimentation (222) permettant d'alimenter des objets de transport (2101) vers les boîtiers de transport, dans lequel chacune des unités d'alimentation comprend :

   un moyen d'alimentation (223) permettant d'alimenter des objets de transport vers chaque boîtier de transport,
   un wagon (242) permettant d'entraîner le moyen d'alimentation parallèlement au boîtier de transport, le moyen d'alimentation comprenant
   un espace de réception permettant de recevoir des objets de transport tout en étant entraîné par un entraînement parallèle ; **caractérisé par**
   une bande de transport (234) disposée entre un côté orifice de réception et un côté orifice de déchargement de l'espace de détection et transportant les objets de transport reçus vers le côté orifice de déchargement.

2. Dispositif de transport/triage selon la revendication 1, dans lequel le moyen d'alimentation est pourvu d'une bande de déchargement permettant de décharger les objets de transport.

3. Dispositif de transport/triage selon la revendication 1, dans lequel
la bande de transport (234) est agencée entre le côté orifice de réception et le côté orifice de déchargement de l'espace de réception et sert à transporter les objets de transport reçus vers le côté orifice de déchargement et à décharger les objets de transport.

4. Dispositif de transport/triage selon l'une quelconque des revendications 1 à 3 et comprenant en outre :

   un rail de guidage d'entraînement parallèle (241) formant un trajet en boucle sans fin ;
   les wagons d'entraînement parallèle (242) étant supportés en mouvement sur le rail de guidage d'entraînement parallèle (241), et se déplaçant le long du trajet en boucle sans fin et supportant le moyen d'alimentation dans un état accouplé.

5. Dispositif de transport/triage selon la revendication 4, dans lequel le rail de guidage d'entraînement parallèle comporte une zone d'alimentation d'entraînement parallèle constituée d'une portion droite.

6. Dispositif de transport/triage selon la revendication 2 ou 3, dans lequel la bande de déchargement ou son côté orifice de déchargement pivote dans la direction d'entraînement parallèle lors de la réception d'une force externe.

FIG.1

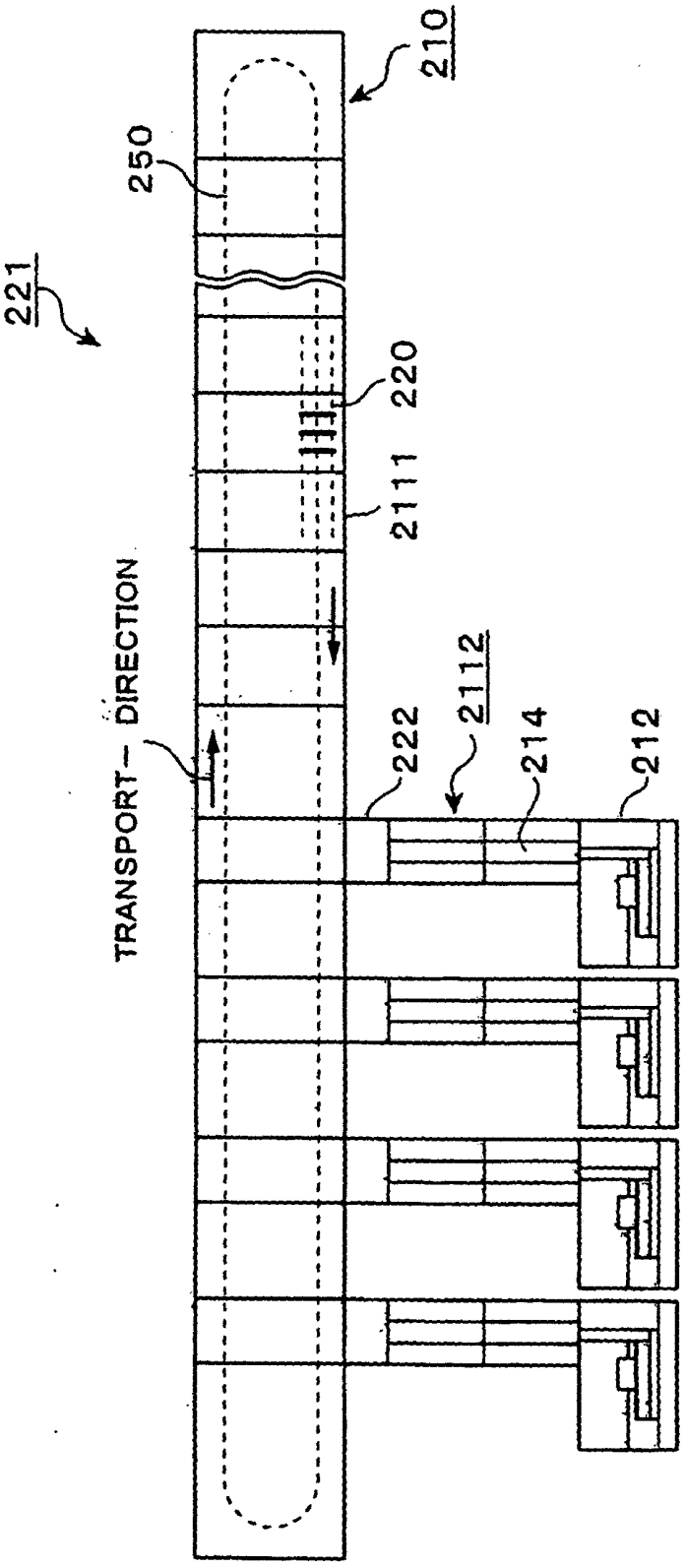


FIG. 2A

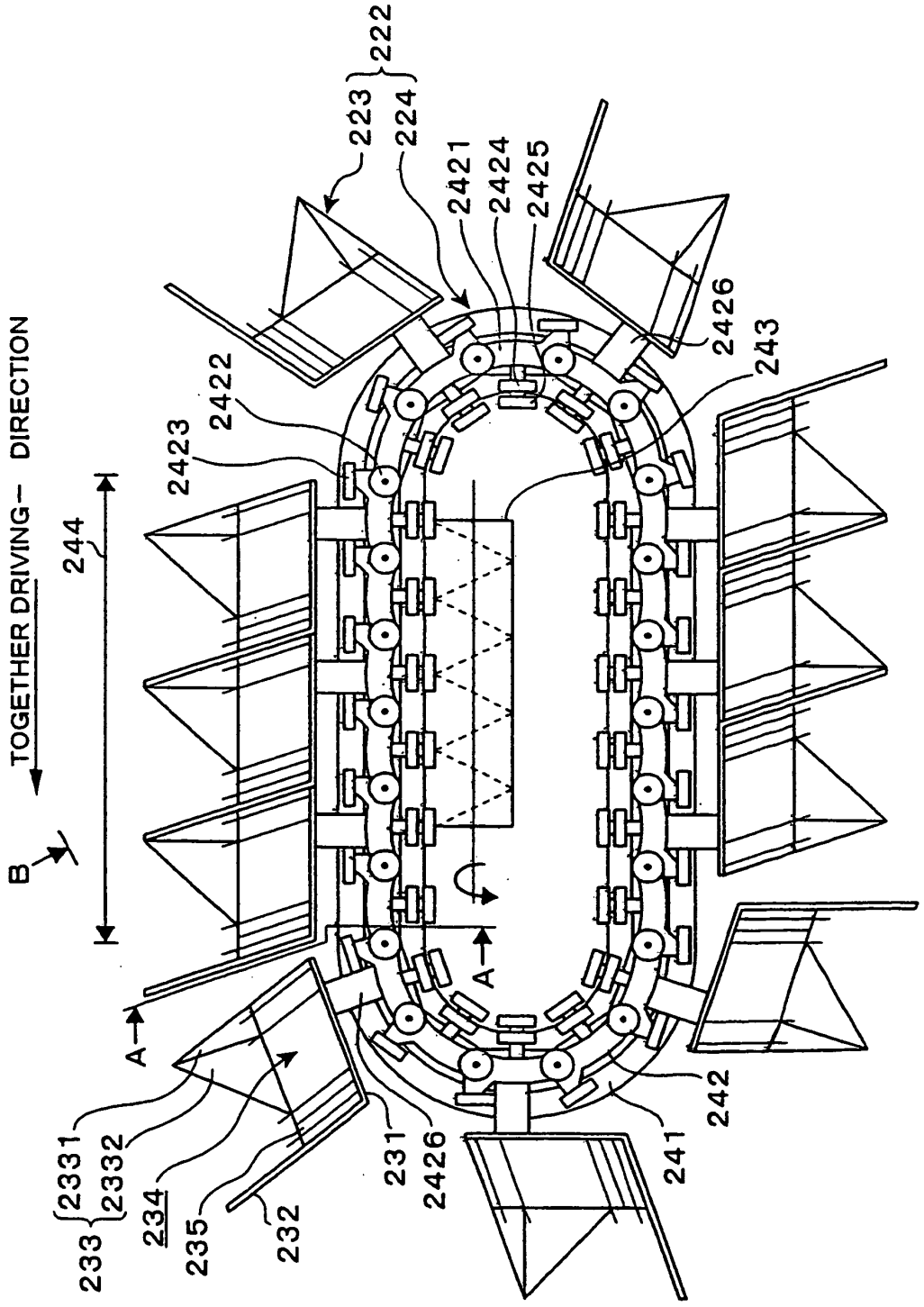

TOGETHER DRIVING— DIRECTION
B
244
A
A
222
223
224
2421
2424
2425
2426
243
2422
2423
2331
2332
233
234
235
232
231
2426
241
242

FIG. 2B

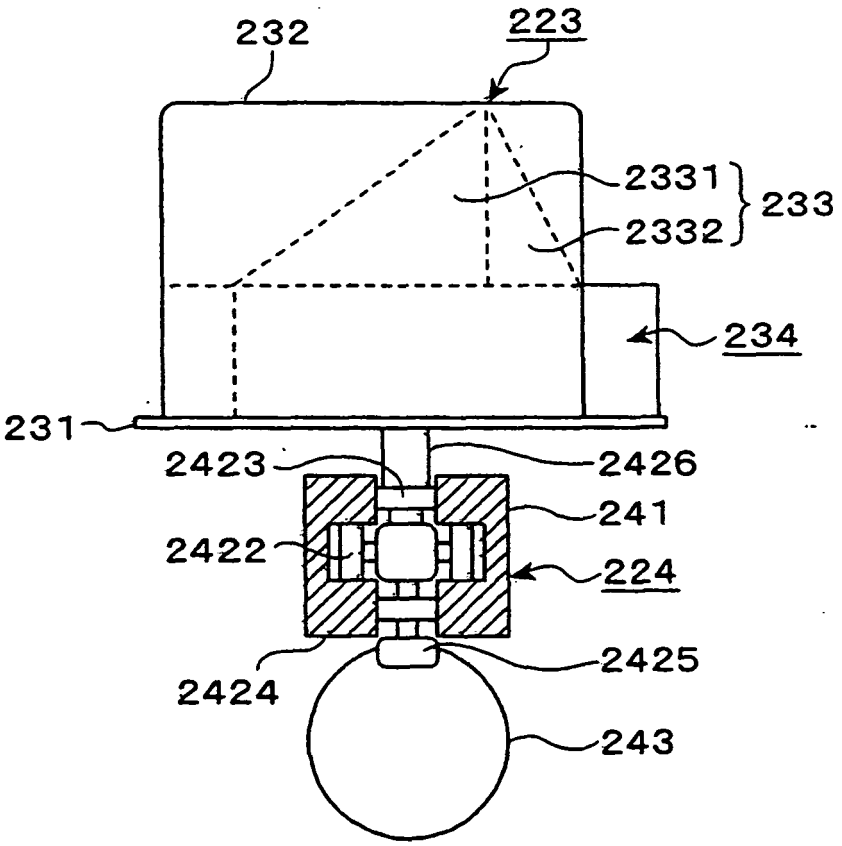

232
223
2331
2332
233
234
231
2423
2426
241
2422
224
2425
2424
243

FIG. 2C

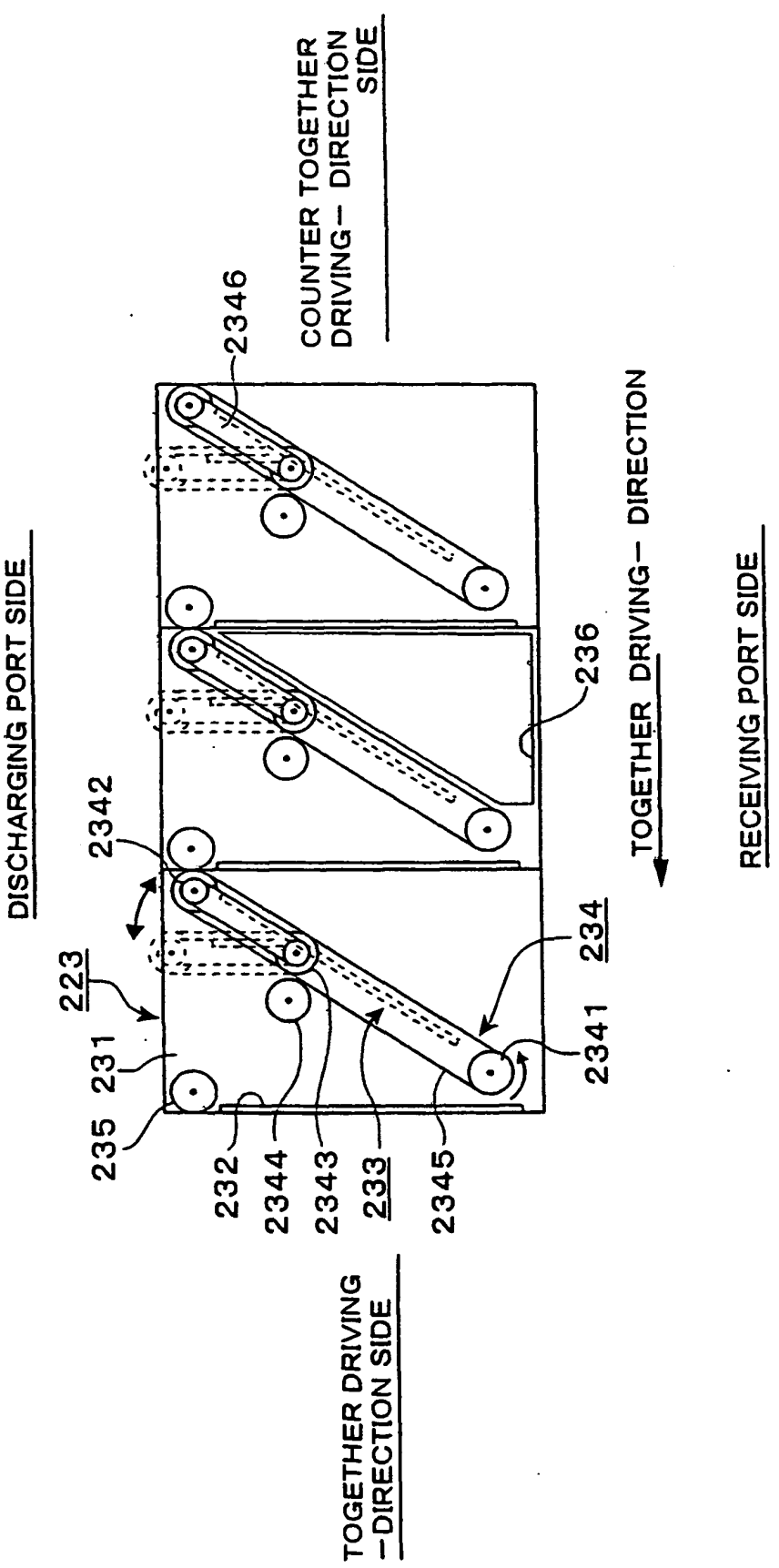

DISCHARGING PORT SIDE
COUNTER TOGETHER DRIVING- DIRECTION SIDE
2346
2342
223
231
235
232
2344
2343
233
2345
TOGETHER DRIVING -DIRECTION SIDE
236
TOGETHER DRIVING- DIRECTION
234
2341
RECEIVING PORT SIDE

FIG. 3A— I

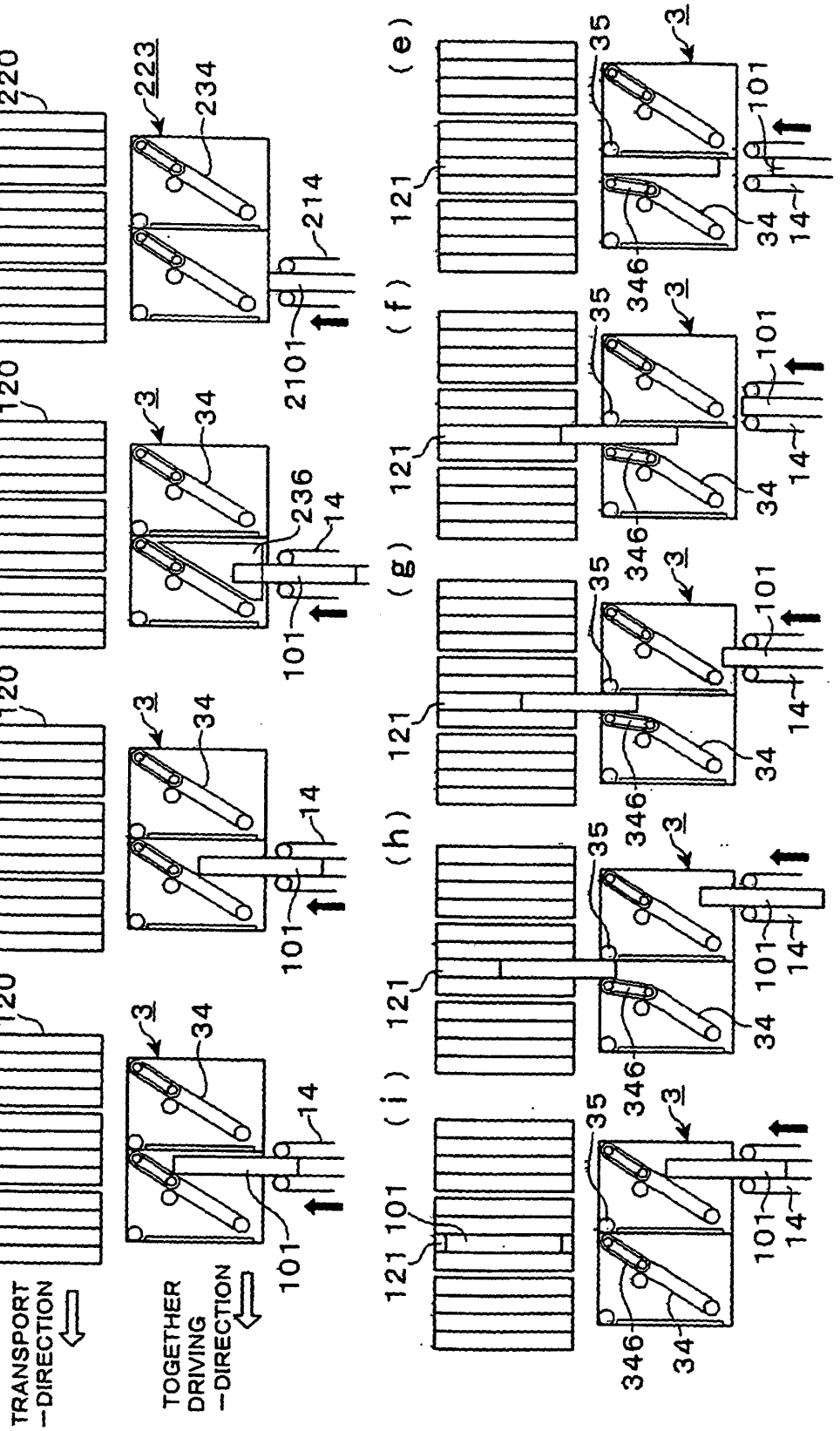

(a)
(b)
(c)
(d)
(e)
(f)
(g)
(h)
(i)
TRANSPORT DIRECTION
TOGETHER DRIVING DIRECTION

FIG. 4

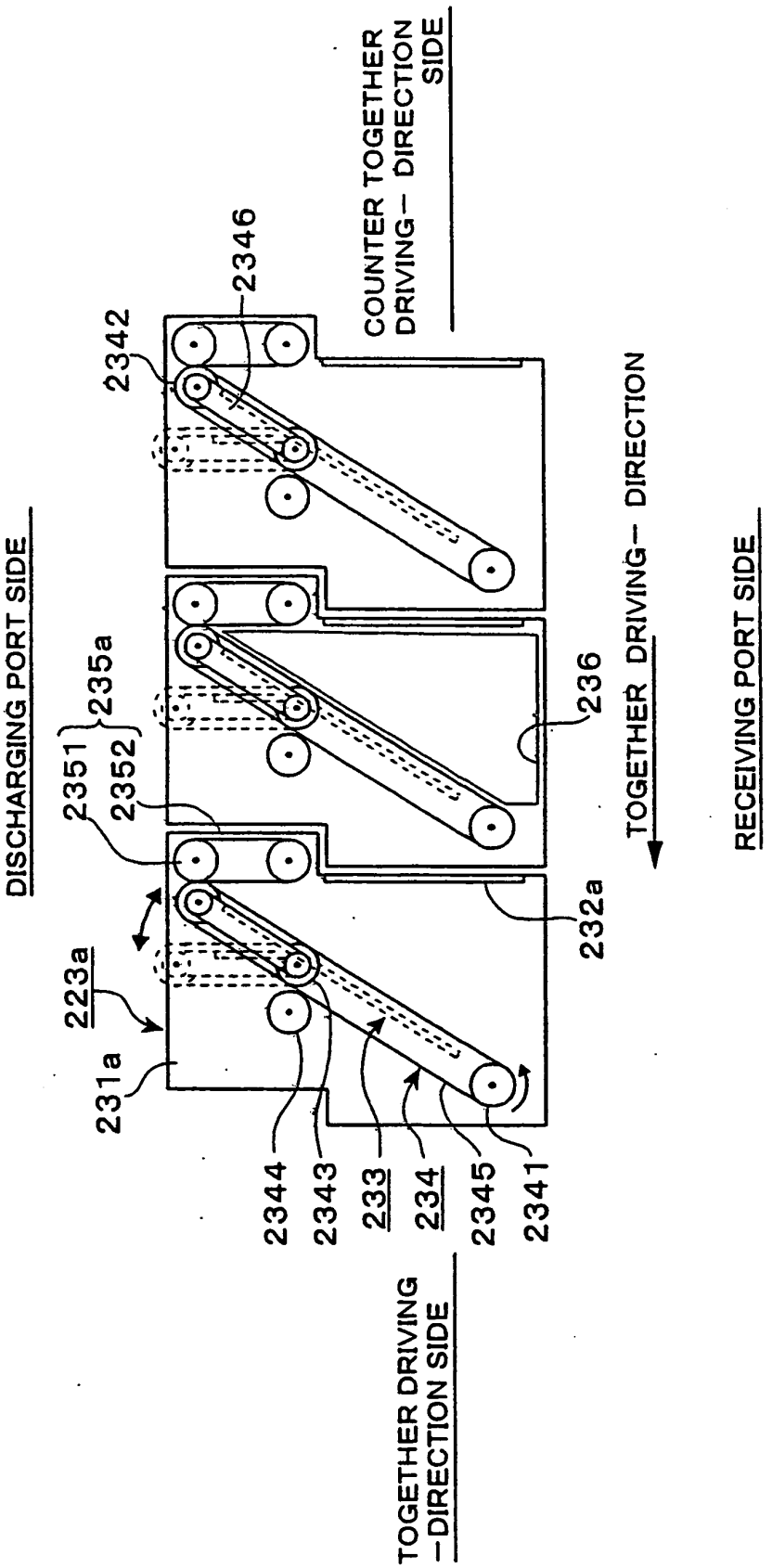

DISCHARGING PORT SIDE
RECEIVING PORT SIDE
TOGETHER DRIVING– DIRECTION
COUNTER TOGETHER DRIVING– DIRECTION SIDE
TOGETHER DRIVING –DIRECTION SIDE
2346
2342
235a
2351
2352
236
223a
231a
232a
2344
2343
233
234
2345
2341

FIG. 5A

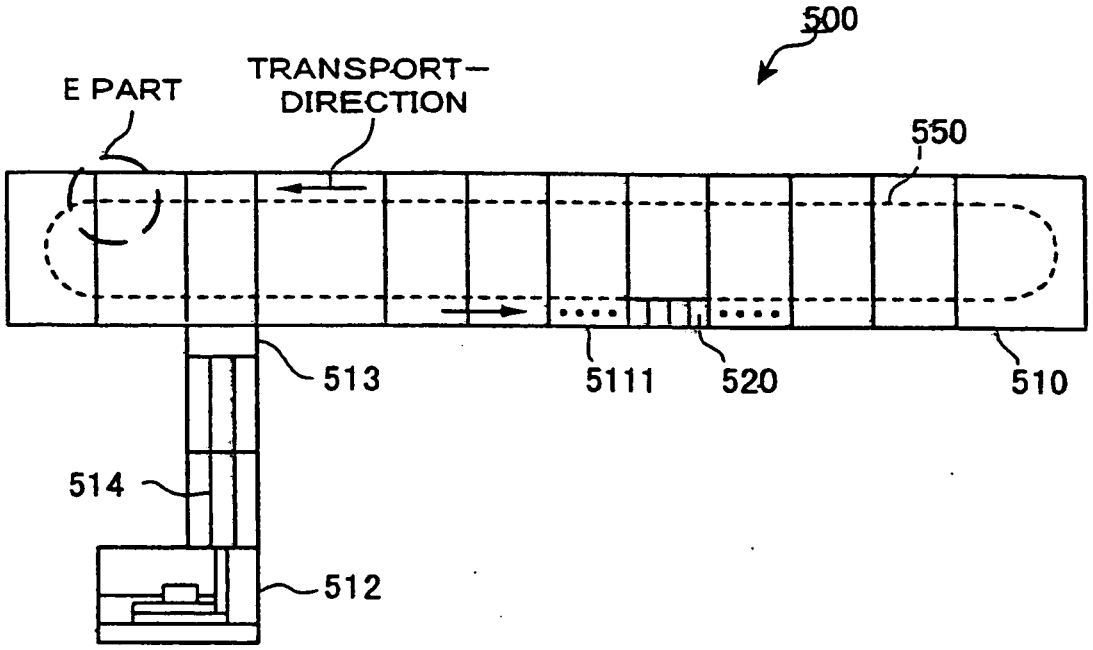


FIG. 5 B

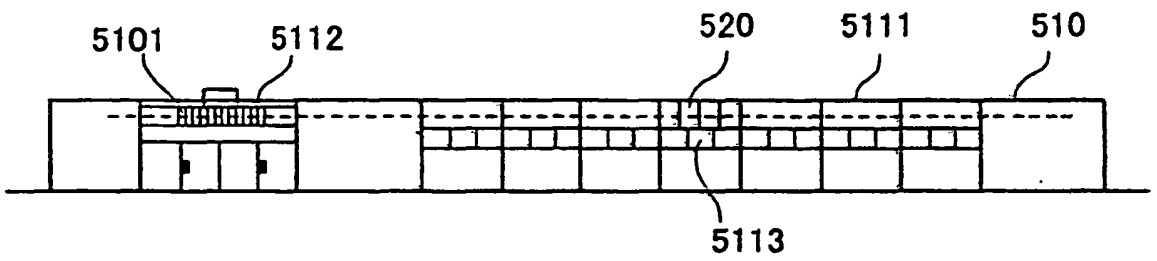


FIG. 6

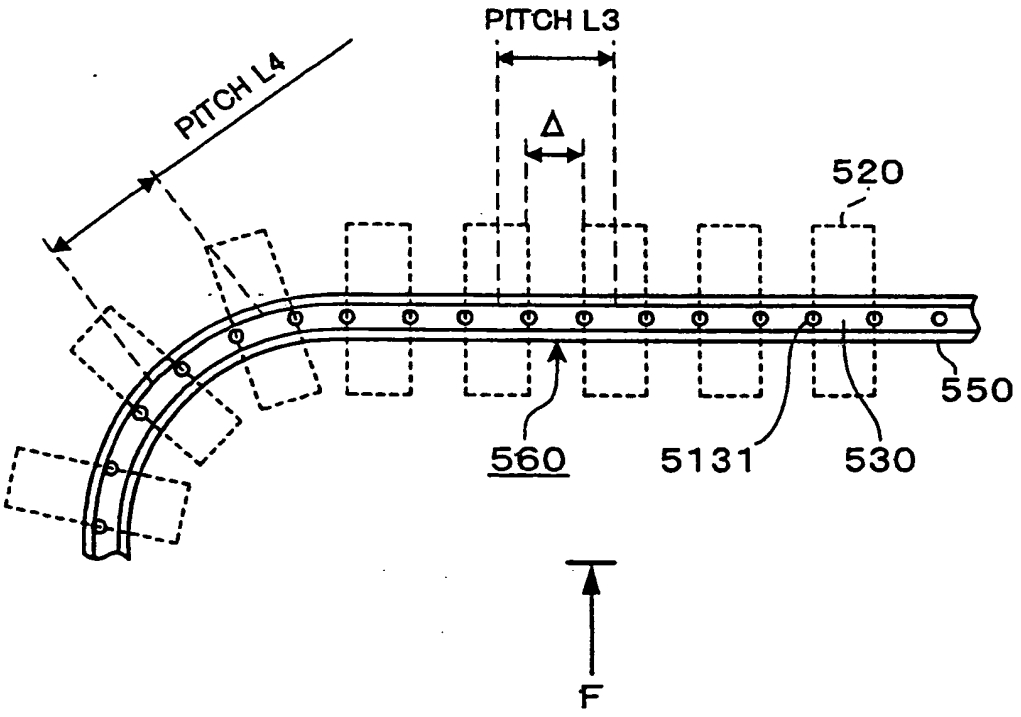


FIG. 7

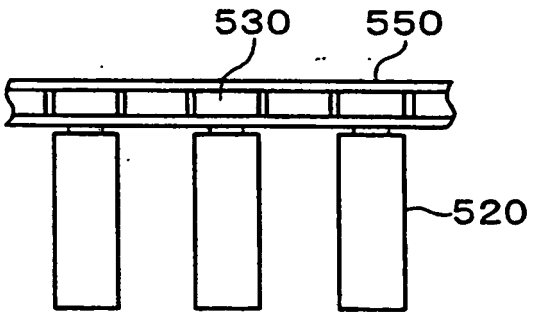


FIG. 8 A

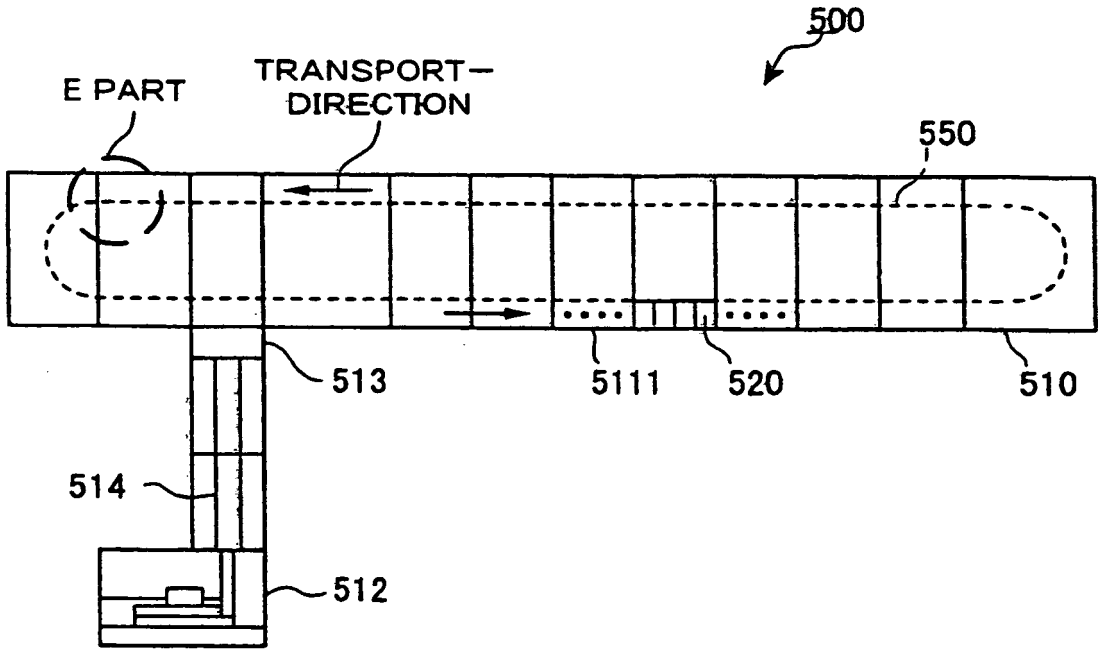


FIG. 8 B

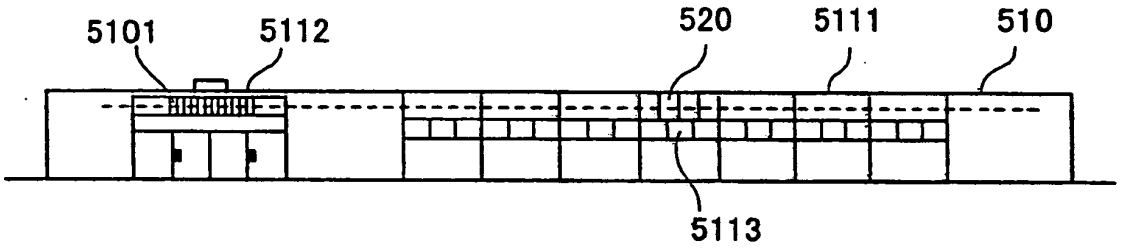


FIG. 9 A

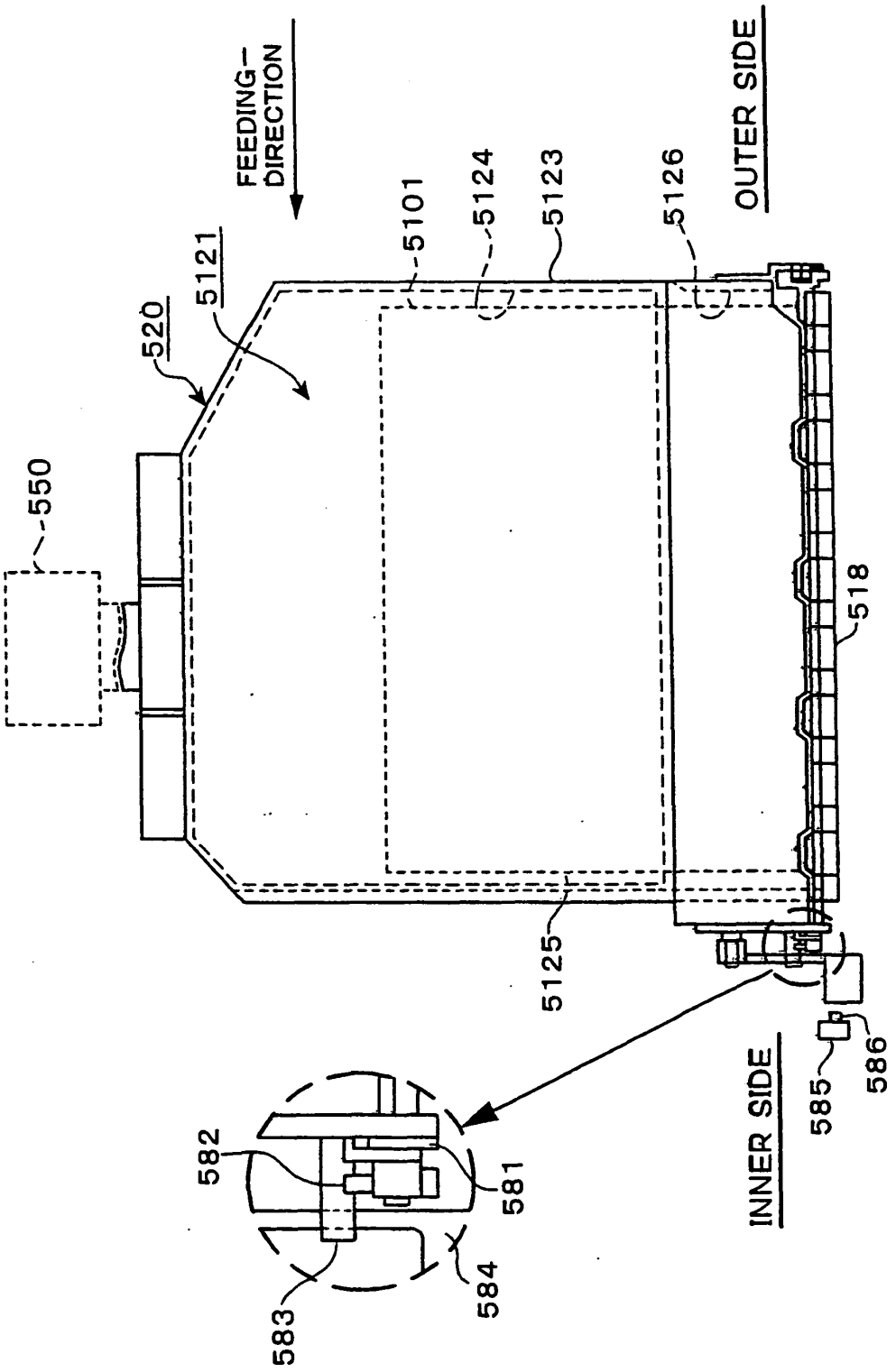

FEEDING DIRECTION
OUTER SIDE
INNER SIDE
550
520
5121
5101
5124
5123
5126
518
5125
585
586
582
581
584
583

FIG. 9 B

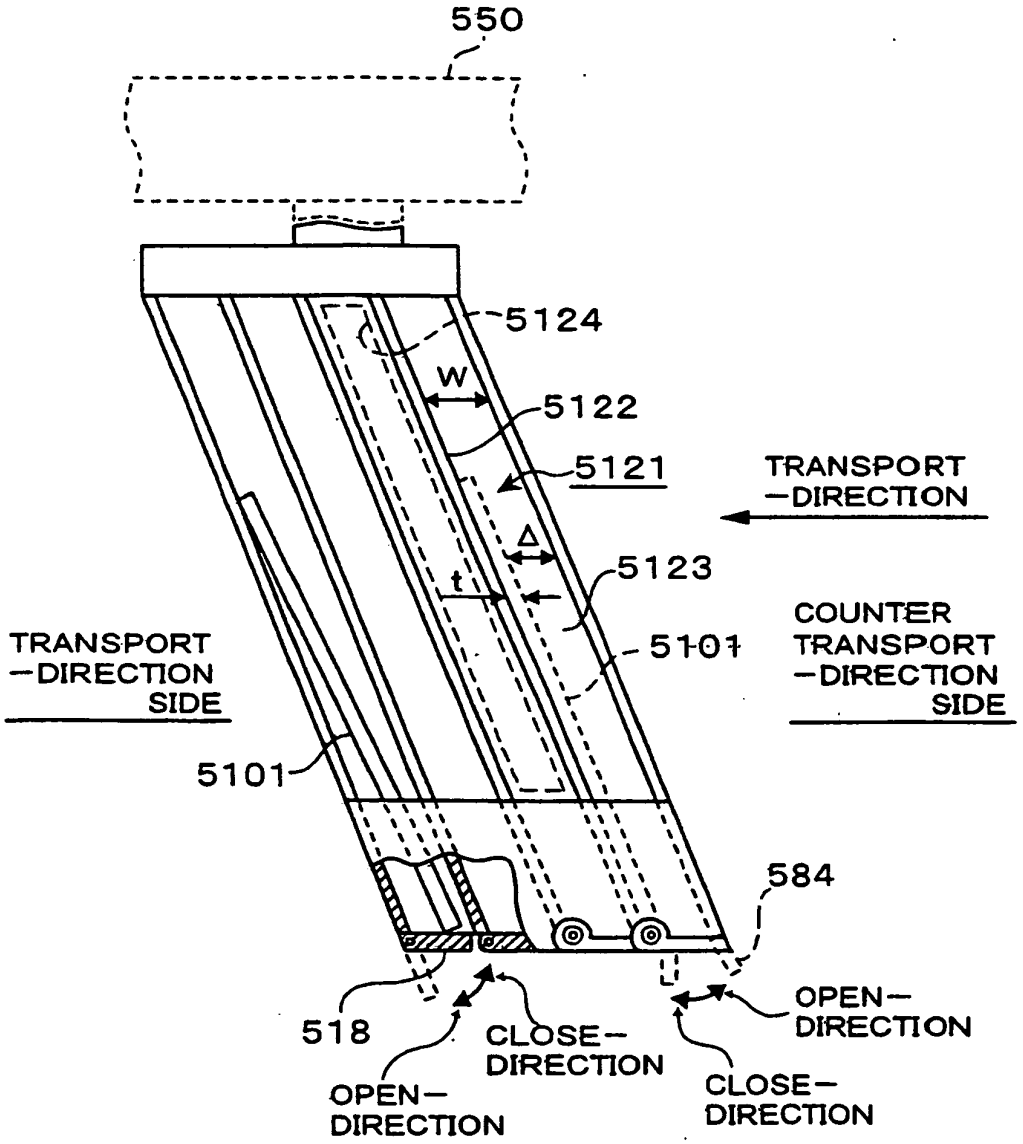

550
5124
W
5122
5121
TRANSPORT
—DIRECTION
Δ
t
5123
COUNTER
TRANSPORT
—DIRECTION
SIDE
TRANSPORT
—DIRECTION
SIDE
5101
5101
584
518
OPEN—
DIRECTION
CLOSE—
DIRECTION
OPEN—
DIRECTION
CLOSE—
DIRECTION

FIG.10A

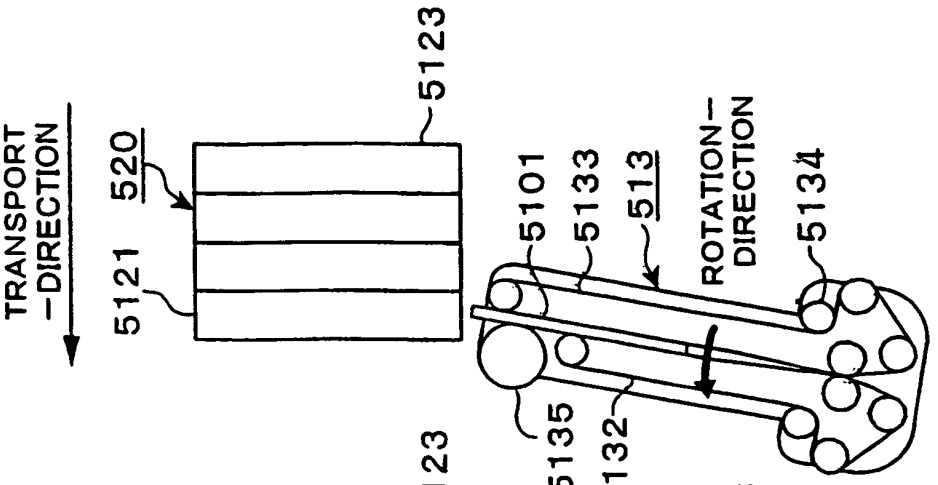



FIG.10B

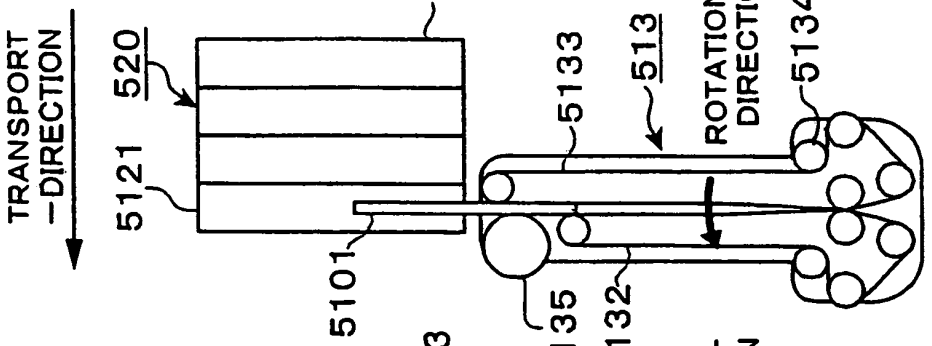



FIG.10C

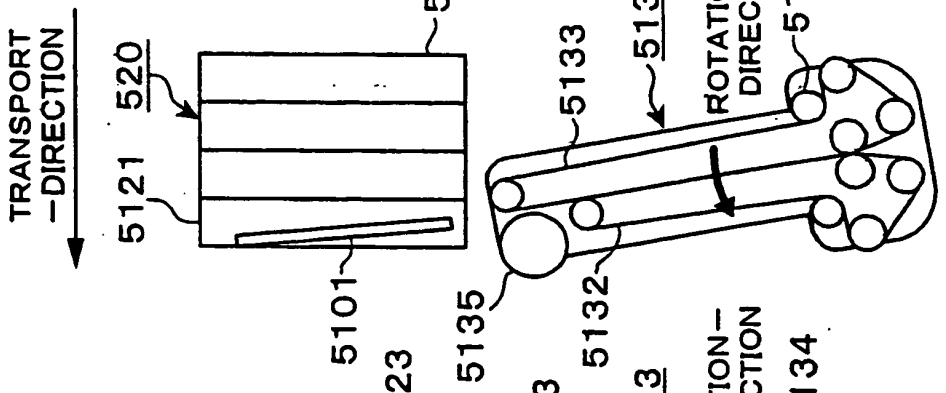
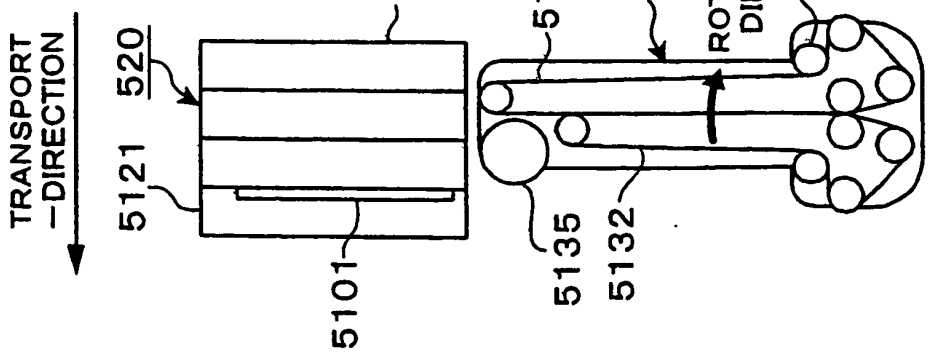



FIG.10D



## REFERENCES CITED IN THE DESCRIPTION

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- EP 0608161 A **[0058]**
- US 2689657 A **[0058]**
- US 6595346 B1 **[0058]**