

[54] CONVEYORS WITH LATERAL DISCHARGE APPARATUS

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[58] Field of Search 209/100, 102, 97, 85, 125, 198/38; 209/123, 74; 214/11

[56]

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[57]

ABSTRACT

A tilted belt sorter includes a belt angularly oriented

with a guide wall at the lower belt edge to support parcels or other loads in longitudinal spaced relation. A plurality of downwardly moving adjacent gates are formed in the wall for lateral dropping discharging into chutes. Each gate is formed with a partial closure wall portion located in the trailing portion of the gate window or opening with the gate in the open position. The closure wall may be a generally wedge shaped member interconnected to the top leading edge of the gate. The inclined edge projects downwardly toward the moving parcels and defines a rising edge surface from an intermediate point in the gate opening to the terminal end of the gate opening. Alternatively, the leading edge of each gate may be provided with a generally wedge shaped edge portion overlapped with the adjacent gate such that the dropping of any given gate exposes the gate opening with the inclusion therein of the trailing wedge portion of the adjacent leading gate. A similar gate opening may also be developed by a pivoting gate which is pivotally mounted along the upper end of the trailing-most edge of the gate such that the leading edge of the gate provides a complete gate opening for the discharging parcel while the trailing portion defines the continued inclined stop wall. The gates minimize the requiring parcel spacing.

18 Claims, 6 Drawing Figures

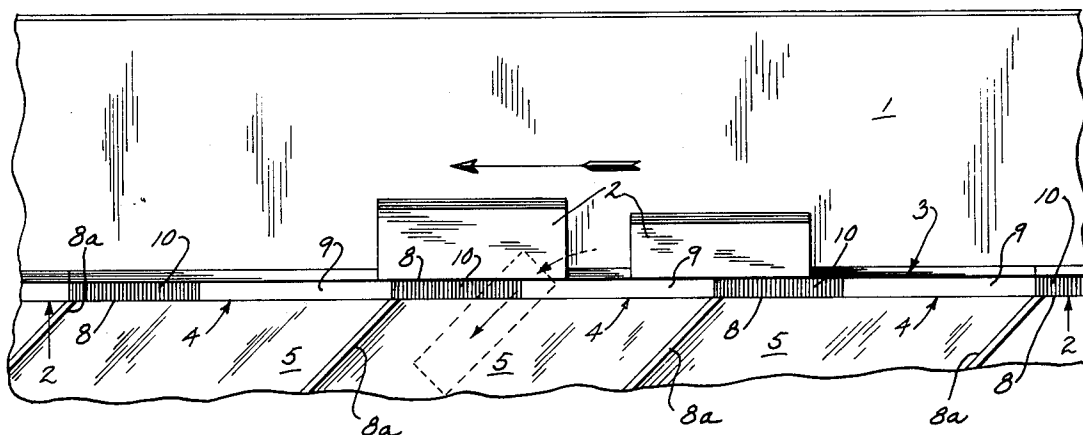


Fig. 1

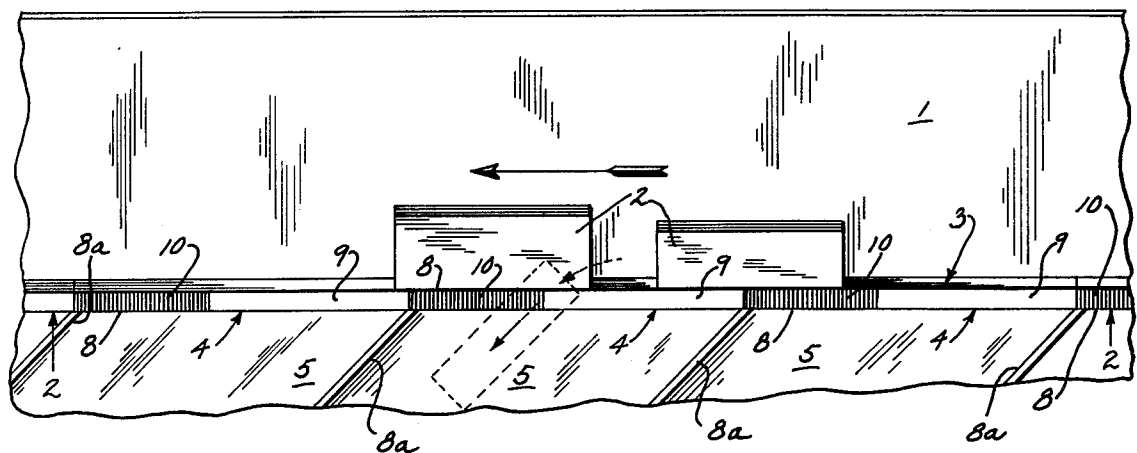


Fig. 2

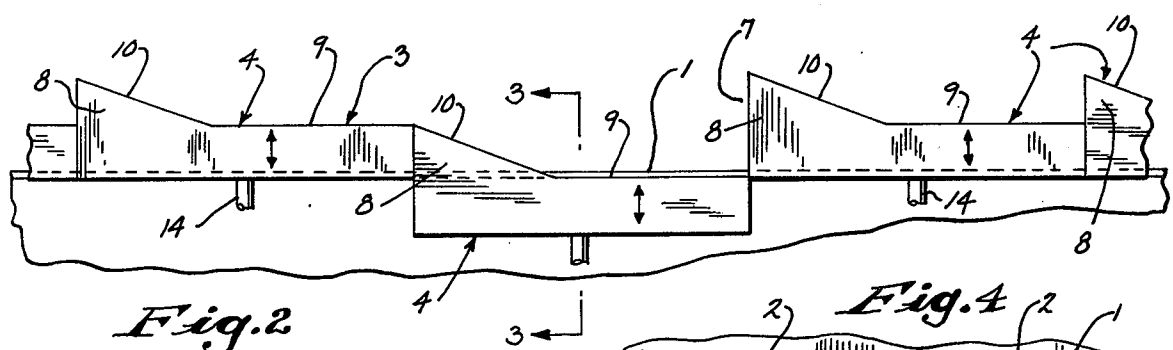


Fig. 4

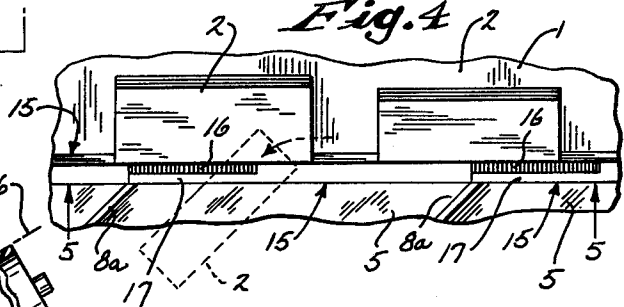


Fig. 5

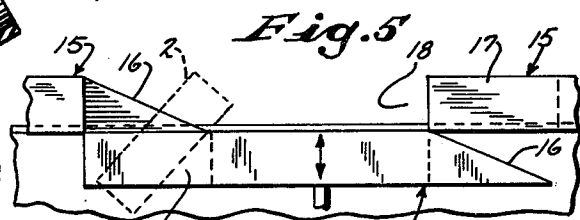


Fig. 3

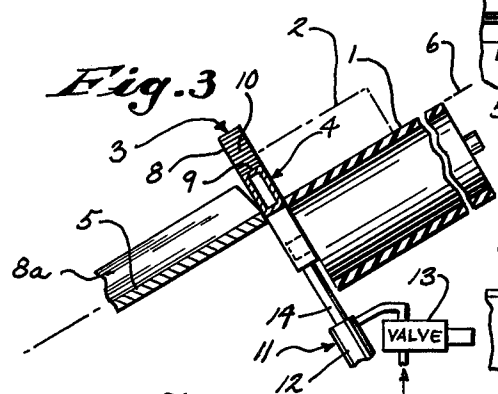
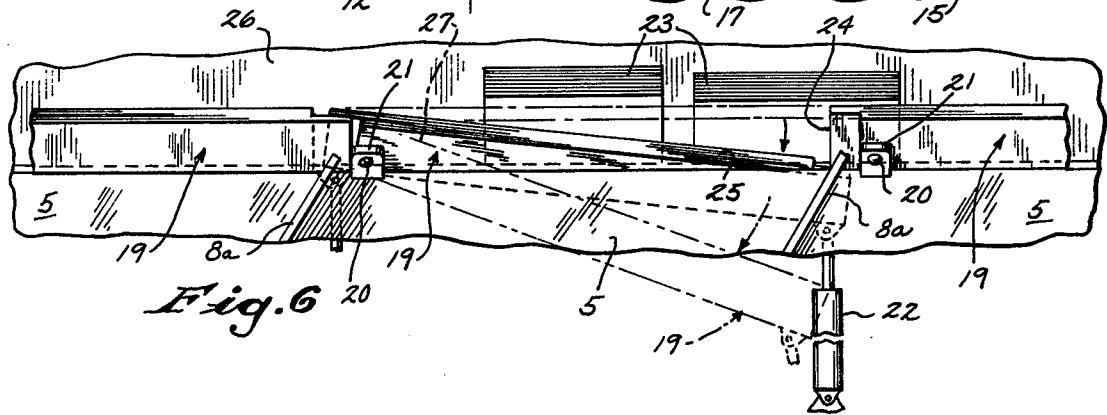


Fig. 6



CONVEYORS WITH LATERAL DISCHARGE APPARATUS

BACKGROUND OF THE INVENTION

The present invention relates to a lateral discharge apparatus for a conveyor and particularly to lateral discharge apparatus for high speed tilt belt conveyors.

In the transfer and sorting of various work units and articles for industrial and commercial application, the load units, or parcels may be randomly carried by a conveying device and automatically discharged at appropriate discharge or receiving stations in accordance with some predetermined sorting plan. Various automatic sorting devices have been suggested for mechanical removal of the load units at the receiving station. A satisfactory slow speed sorter employs a tilted belt conveyor with a load conveying belt angularly oriented with respect to the horizontal and with the articles retained on the belt at the lower edge of the belt by a stop guide wall which extends upwardly normal to the belt plane. The guide wall includes appropriately located gates which can be removed from the supporting position for allowing an aligned article to discharge under gravity forces. Generally, such devices have been employed in relatively low speed application where the conveying belt is moving at a maximum order of 150 feet per minute. Thus, in parcel sorting, such as in large warehouses for department stores, other merchandise type operations and the like, tilt belt sorters have been employed for low speed separating of the parcels into interrelated destination groups. At higher speeds, the gate must be so large and the spacing between articles so great as to make the system impractical. The spacing of the articles of course must be sufficient to ensure that the desired article is discharged and the gate replaced before the preceeding article moves into alignment with the lowered gate. Further, the following or trailing article must be out of the gate area before the gate is opened. Further at high speeds, the package is given sufficient forward inertia force that engagement with the gate wall opening to the trailing side of the opening may occur and possibly damage the article. Generally, the tilt belt sorters have been primarily employed at slow speeds and for applications of relatively minimum sorting requirement.

Where higher speed sorting is required, various sweeping and beating systems have been developed with the articles carried by a horizontal conveyor and a positive lateral motion imparts to an article by an unloading member when the article is aligned with a particular discharge location, which may or may not include some form of a gate structure. Although such structures may provide a satisfactory discharge, care must be taken to provide appropriate timed movement of the unloading mechanism without interference with the other articles and without damages to the removed articles. Further, the complexity of the overall mechanism to provide the desired removal characteristic may require a significant cost factor which tends to limit the practical use thereof. Thus there is a need for a simple and reliable lateral discharge apparatus particularly for high speed sorters and the like.

SUMMARY OF THE INVENTION

The present invention is particularly directed to a conveying apparatus including a lateral discharge gate means which permits the rapid lateral discharge of a

unit while minimizing any possible damage to the unit or the apparatus and minimizing the required gate length and/or spacing of the units on the conveying apparatus. Generally, in accordance with the present invention the gate means is formed with a partial closure wall portion located in the trailing portion of the gate window or opening with the gate in the open position. The partial closure wall portion includes an inclined wall extending from the belt plane upwardly to provide a partial stop wall which supports a trailing unit while simultaneously permitting the convenient discharge of a leading unit which has initiated its movement into the gate opening. Applicant has found that the present invention is particularly adapted to the tilting belt type sorter and, in fact, that such a sorter can be operated at a speed of the order of 400 feet per minute while maintaining reliable lateral discharge of conveyed units.

In accordance with a particularly novel feature and construction of the present invention, a belt conveyor is mounted with the plane of the belt angularly oriented from the horizontal plane. A guide wall is formed adjacent to the lower belt edge with a smooth generally vertical surface projecting such that the parcels are carried on the belt riding on the smooth wall upwardly normal to the belt plane surface. At appropriate discharge locations, receiving chutes or similar means are provided in alignment with the lower edge of the belt and the wall. A vertically downwardly moving gate is formed in the wall at each chute. The gate may be formed as a continuation of the wall with a generally wedge shaped member interconnected to the top trailing edge of the gate. The wedge portion is of a significantly shorter length than the total length of the gate or window opening defined by dropping of the gate. The lowered gate locates the trailing wedge portion within the opening. The inclined edge projects downwardly toward the moving parcels and the direction of conveyor and defines a rising edge surface from an intermediate point in the gate opening to the terminal end of the gate opening. Thus, in operation the gate is dropped downwardly as the discharging parcel is moved into the leading and entrance portion of the gate opening. The article moves, under the force of gravity, downwardly into the gate opening. Depending upon the size of the parcel, and the movement of the conveyor and the lateral speed of discharge, the parcel may or may not completely discharge through the entrance portion of the gate opening. If it does not it will merely move into engagement with the generally inclined wall and move up and over, continuing its downward movement into the chute. In fact, Applicant has found that the characteristic is such that, in fact, the gate action apparently due to the increased velocity of the total system is such that the inertia forces on the package permit the dropping of the gate and the initiation or raising of the gate long prior to the complete movement of the parcel through the gate. As the speed increases, the inclined wall structure also further acts on a discharging parcel to turn the parcel such that it moves downwardly through the chute or gate structure thereby minimizing the necessary length of the gate opening.

Further, the inclined wall portion minimizes the complete open gate portion such that a trailing parcel need only partially clear the total gate opening sufficiently to engage the wedge portion during the dropping of the gate to maintain its movement along with the conveyor

as desired. This, thus, further minimizes the required spacing between parcels and additionally contributes to the capacity of the conveying or sorting apparatus.

Alternatively, the leading edge of each gate may be provided with a generally wedge shaped edge portion in the gate opening and overlapped with the adjacent raised gate such that the dropping of any given gate exposes the gate opening with the inclusion therein of the inclined edge of the adjacent trailing gate. Alternatively, a similar construction or gate opening may be developed by a pivoting gate which is pivotally mounted along the upper end of the trailing-most edge of the gate such that the leading edge of the gate provides a complete gate opening for the discharging parcel while the trailing portion defines the continued inclined stop wall.

The gate structure is particularly adapted to increasing the speed of the conventional belt sorter or the like by minimizing the required gate opening and ensuring complete discharge of the parcel without dangerous engagement with the conveyor or discharging mechanism as it is discharged. The present invention thus provides a very simple and reliable discharge gate unit for lateral discharge of packages from a conveying apparatus.

BRIEF DESCRIPTION OF THE DRAWINGS

The drawings furnished herewith illustrate the best mode presently contemplated by the inventor for carrying out the invention in which the above advantages and features are clearly disclosed as well as others which will be readily understood from the following description.

In the drawings:

FIG. 1 is a fragmentary plan view of a tilt belt sorter employing a gate structure constructed in accordance with the present invention;

FIG. 2 is a view taken generally on line 2—2 of FIG. 1 normal to the plane of the belt shown in FIG. 1;

FIG. 3 is a vertical section taken generally on line 3—3 of FIG. 2 and more clearly illustrating the structure;

FIG. 4 is a fragmentary top view of an alternative gate structure in accordance with the present invention;

FIG. 5 is a view taken generally on line 5—5 of FIG. 4; and

FIG. 6 is a front elevational view illustrating a still further embodiment of the present invention constructed in accordance with the present invention.

DESCRIPTION OF ILLUSTRATED EMBODIMENTS

Referring to the drawings and particularly in FIGS. 1—3, the invention is illustrated in connection with a tilt belt sorter which includes an inclined endless belt 1 suitably mounted for rectilinear movement with a plurality of parcels 2 supported in longitudinally, spaced relation thereon. The belt is mounted, as more clearly illustrated in FIG. 3, at an incline to the horizontal plane such that the parcels or articles 2 ride downwardly to the lower edge of the belt 1. A guide or stop wall 3 is formed along the lower edge of the belt 1 to positively support the parcels 2 for linear movement with the belt 1. The wall 3 is provided with a plurality of one or more similar discharge gates 4 aligned with corresponding chute structures 5. The gates 4 are shown in immediate adjacent end-to-end relation and

each is movable perpendicular to the normal plane 6 of the belt 1. Each gate 4 is specially constructed and moves vertically downwardly below the level of the belt 1 to permit gravity discharge of an aligned parcels 2 through a unique gate window or opening 7 generated by dropping of a gate 4. Generally each gate 4 includes a wedge shaped structure 8 located within the trailing portion of the gate opening 7.

The wedge shaped portion 8 spans substantially less than the total length of the opening 7 and in particular somewhat less than one-half the opening. Thus, when a gate 4 is dropped there is an entrance portion of the discharge opening or window for the discharging parcel 2 and a partially closed trailing portion defined by the wedge shaped structure 8 and most clearly shown by FIG. 2. As the discharging parcels 2 is moved through the window or opening 7 and into aligned chute 5, the parcel 2 may not be completely transferred through the complete open portion and be propelled into engagement with the incined upper wall of the wedge shaped structure 8. The parcel 2 readily moves over the inclined portion and downwardly through the chute structure 5. The parcels 1 may be any suitable individual packages or units which it is desired to selectively sort at predetermined stations. Thus, generally, the present invention may conveniently be applied, for example, to a post office operation where parcels are separated by predetermined areas or groupings. Similarly, warehousing order separation is preferably done through an automatic sorting mechanism such as shown by random feeding of parcels 2 to a tilt belt sorter, with the automatic actuation of the gates 4 to discharge the parcels 2 at appropriately key coded discharge chute 5.

The chute 5 structures may be suitable generally U-shaped sheet metal members having a flat base in the plane of belt 1 and trailing and leading guide walls 8a to properly direct the package downwardly to a receiving means, not shown. The guide wall 3 may be of any suitable construction and is shown generally as formed of a sheet metal box-like wall construction to provide adequate support for the parcels.

The gates 4 are similarly illustrated as an integral part of the wall 3 and formed as lightweight metal members of a similar box cross section having top, flat walls 9. The wedge shaped structure 8 is formed as an integrated extension of the upper leading wall of the gate 4 and define a flat, inclined top wall 10 extending upwardly from the top, flat wall 9 of the gates. In the illustrated embodiment of the invention, the gates 4 are shown supported by a suitable pneumatic cylinder unit 11 located beneath belt 1. The cylinder unit 9 includes a fixed cylinder 12 coupled to a suitable pneumatic pressure supply through a solenoid controlled valve unit 13. The piston rod 14 of the cylinder unit 11 is coupled to the gate 4 and holds the gate 4 in the raised closing position with the cylinder unit 11 supplied with fluid pressure. When a parcel 2 moves into a trailing portion of a discharging gate 4, the cylinder unit 11 is activated to rapidly retract and thereby lower the gate 3 with the flat, top wall 9 of gate 4 in the plane of the belt 1 to form an extension thereof into the chute 5.

The wedge structure 8 thus effectively closes the trailing end portion of the discharge gate opening 7 so as to retain the trailing parcel 2 on the conveying belt 1. This is highly desirable as it permits relatively close spacing of the parcels 2 and thereby increases the over-

all capacity of the sorter while maintaining reliable and accurate discharge and sorting of the parcels. Further, the discharging parcel in engaging the inclined wall is smoothly and accurately directed into the chute without any damaging interference such as occurs with relatively flat walls heretofore employed in gate structure.

The wedge shaped structure 8 of the gate 4 thereby effectively maximizes the size of the discharge window or opening for a discharging parcel while minimizing the size of such window or opening with respect to the parcel 2 immediately following the discharging parcel 2. The present invention, as noted, is particularly adapted to high speed sorting because of the reduction in the gate opening requirements. Further, Applicant has found that, in fact, a gate 4 can be lowered and then the raising movement initiated long prior to the actual complete movement of the parcel 2 through the gate opening 7. Even though the gate 4 is partially raised, for example as shown in FIG. 4, the partially discharged parcel is impelled downwardly through the chute by the inertial and gravity forces action thereon. The movement into the inclined structure tends to accentuate the turning action and dropping of the package properly onto the chute structure. This action is desirable in further minimizing the spacing requirements between the discharging package and the preceeding or leading package. Thus as soon as the leading most edge of a gate 4 rises significantly above the level of the belt 1, the top portion of the vertical wall thereof forms a stop for any parcel 2 moving into the gate area. Consequently, thus even though a leading parcel 2 moves into the gate area before the discharging parcel 2 is completely discharged, the stop wall 3 is raised sufficiently to prevent movement of the leading parcel into the gate area and, consequently further contributes to high speed sorting construction or operation. Applicant has found that the gate may be started to close upwardly to the closed position immediately after the package has moved over the gate unit as such.

Any other means can, of course, be provided to define a similar partial inclined wall closure within the gate opening. For example, as shown in FIGS. 4 and 5, the leading edge portion of each of a plurality of adjacent gates 15 is provided with a longitudinally extending triangular wedge portion 16 to form a portion of the guide wall. The wedge portion 16 of each gate 15 extends into a correspondingly shaped pocket portion 17 in the immediately adjacent leading gate 15. Thus, when a gate 15 is dropped as shown in FIG. 5 the triangular wedge 16 portion of the immediately following or trailing gate 15 projects into the gate opening 18 and forms again a partial closure similar to that illustrated in FIG. 2. Generally, the illustrated gate structure 15 will function in the same manner as that described with respect to FIGS. 1-3.

Further, the wedge-shaped partial closure portion 16 could readily be formed as a fixed wall portion within the gate opening. The construction preferably provides a smooth guide wall with the gate structure in the raised or closing portion as shown in the embodiment of FIGS. 4 and 5.

A further embodiment is illustrated in FIG. 6, wherein a gate structure 19 is formed as a generally rectangular box-like member defining a stop wall similar to that illustrated in the previous embodiments. The gate structure however is pivotally mounted adjacent the trailing most end as at 20 upon a relatively fixed

wall portion 21. The opposite or free end of the gate is mounted and positioned by a suitable positioning device, such as a hydraulic cylinder unit 22. When a parcel 23 is to be discharged the gate structure 19 is pivoted downwardly, as illustrated, to open the leading portion of the gate window or opening 24. When the gate structure has dropped downwardly to completely locate a significant portion of the top wall or edge 25 below the plane of the belt 26, a parcel 23 will discharge, generally as previously described. Thus, the dropped position the trailing portion of the gate 19, defines an inclined partial closure 27 across the leading portion of the gate.

The discharge parcel 23 moves into and through the window opening and at high speed move onto the inclined diverting wall 25 defined by the pivoted gate. The pivoted gate thus functions in essentially the same manner as that previously described. Further, the return of the pivoted gate 19 can be initiated prior to complete discharge of the parcel as a result of the interaction between the conveying element, the inclined belt and the gate structure.

Thus, generally, in accordance with the present invention, a tilt belt sorter is provided with a gate structure having a partial closure member for the trailing portion of the gate opening and with such partial closure especially constructed to define an inclined ramp structure. Although shown as a rectilinear or straight-line wedge shaped wall, the upper edge or wall may of course have any desired configuration including concave, convex or any combination.

The present invention thus provides a reliable, relatively simple and inexpensive gate structure particularly adapted for a tilt belt sorter and the like.

Various modes of carrying out the invention are contemplated as being within the scope of the following claims, particularly pointing out and distinctly claiming the subject matter which is regarded as the invention. I claim:

1. In a conveying apparatus for moving a plurality of individual load units in physically longitudinally spaced relationship in a longitudinal path and selectively laterally moving of said units along a lateral path at preselected discharge stations, the combination comprising, discharge gate means extending longitudinally of the moving load units in said lateral path of load units with a leading portion and a trailing portion and defining a stop wall in said lateral path, means for lowering of said gate means downwardly with respect to said load units and defining a gate opening with a leading portion and a trailing portion and permitting lateral discharge along said lateral path, and partial closure means for partially closing of the trailing portion of the gate opening defined by a lowered gate means, said partial closure means including an inclined wall surface located within said discharge opening, said wall surface extending longitudinally upwardly within the opening and thereby directing a load unit upwardly within the opening as the load unit moves through the corresponding portion of the discharge opening.

2. The conveying apparatus of claim 1 wherein a conveying endless belt is mounted with the plane of the belt angularly related with respect to a horizontal plane to carry said load units and gravity biasing the conveyed load units downwardly toward the lower end of the belt, said gate means projecting upwardly above the lower edge of the belt and defining a sliding stop wall

along which the units are slidably transferred with the belt, said gate means being located in said wall means.

3. The conveying apparatus of claim 1 wherein said partial closure means are connected to and move with the gate means,

4. The conveying apparatus of claim 3 wherein said gate means include a plurality of individual gates.

5. The conveying apparatus of claim 1 having means for positively positioning said gate means between the raised and lowered positions, said means being operable to initiate raising of the gate means with a parcel within the gate opening.

6. A tilt sorter comprising a conveying member mounted angularly related with respect to a horizontal plane and thereby gravity biasing conveyed load units downwardly toward the lower edge of the conveying member, a wall means at the lower edge of the conveying member projecting upwardly from the supporting surface and defining a stop wall, said wall means including gate means movable downwardly below the plane of said conveying member to thereby permit lateral gravity assisted discharge of said conveying units, said gate means including a leading portion movable with its upper wall below the top plane of the conveying member so as to provide an unrestricted discharge opening for movement of the units, a partial closure member in trailing portion of the opening and having an inclined wall extending upwardly of said discharge opening with the gate in the discharge position so as to support a trailing unit aligned with the trailing portion of the discharge opening and thereby maximizing the discharge opening for a discharging unit while minimizing the opening for other units and thereby minimizing spacing between adjacent units.

7. The sorter of claim 6 wherein said gate means includes a plurality of adjacent aligned gate elements defining immediately adjacent discharge openings, and said partial closure means being connected to the gate elements.

8. The sorter of claim 6 wherein said gate means includes a generally rectangular gate member defining an elongated gate opening, said partial closure member being a generally wedge shaped member having a flat inclined top wall extending longitudinally upwardly across the trailing portion of the gate opening.

9. The sorter of claim 6 wherein said conveying member is a belt mounted with the plane of the belt angularly related with respect to a horizontal plane, said wall means extends along the lower edge of the belt and projects upwardly above the top surface of the belt and defining a sliding stop wall along which the units are slidably transferred with the belt.

10. The sorter of claim 9 wherein said gate means includes a leading top wall movable downwardly to the plane of said belt to provide a continuous lateral gravity assisted discharge surface, said partial closure member including a flat wall extending upwardly from said top wall of a lowered gate means.

11. The sorter of claim 6 wherein said gate means includes a generally rectangular gate member defining an elongated gate opening, said partial closure member including a generally wedge shaped member secured to the upper wall of the rectangular gate member and extending longitudinally partially across the trailing portion of the gate member.

12. The sorter of claim 9 wherein said gate means includes generally rectangular gate wall members corre-

sponding essentially to the length of the gate opening and movable normal to the belt to locate the upper wall of said rectangular gate member in the top plane of the belt, each of said rectangular members including a generally wedge-shaped leading portion extending longitudinally of the belt structure and mounted in overlapping relationship with an immediately adjacent gate member whereby the dropping of the one gate member exposes the leading wedge-shaped of the immediately preceding gate member to define said partial closure.

13. The apparatus of claim 9 wherein each of said gate means includes a gate member pivotally mounted for movement in the plane normal to the plane of the belt, each of said gate means being pivotally mounted adjacent the trailing ends thereof, the leading end thereof being selectively positioned to locate the gate in the stop wall position and being pivoted downwardly such as to lower the leading portion of the gate below the plane of the belt to thereby provide a completely unrestricted discharge opening portion with the trailing portion of the gate member angularly extending across the discharge opening and having an upper wall portion thereof shaped to define the inclined wall surface.

14. The sorter of claim 9 wherein said gate means includes generally rectangular gate wall members corresponding essentially to the length of the gate opening and movable normal to the belt to locate the upper wall of said rectangular gate member completely in the top plane of the belt, each of said rectangular members including a generally wedge-shaped leading portion extending longitudinally of the belt structure and mounted in overlapping relationship with an immediately adjacent gate member whereby the dropping of the one gate member exposes the leading wedge-shaped portion of the immediately following gate member to define said partial closure.

15. The sorter of claim 9 wherein each of said gate means includes a gate member pivotally mounted for movement in the plane normal to the plane of the belt, each of said gate means being pivotally mounted adjacent the trailing ends thereof, the leading end thereof being selectively positioned to locate the gate in the stop wall position and being pivoted downwardly such as to lower the leading portion of the gate below the plane of the belt to thereby provide a completely unrestricted discharge opening portion with the trailing portion of the gate member angularly extending downwardly across the discharge opening and having an upper wall portion thereof shaped to define the inclined wall surface.

16. The sorter of claim 15 wherein said gate member has a flat top wall defining said inclined wall surface.

17. The sorter of claim 6 wherein said partial closure member mounted in fixed relation with the trailing portion of the gate opening to maintain said partial closure thereof when the corresponding gate means moves downwardly.

18. The method of laterally removing loads from a conveying means, comprising moving the loads in spaced relation along a given path in a first direction past a plurality of gate openings at selected unloading stations, said gate openings extending longitudinally of the path and having a leading portion and a trailing portion, selectively moving the loads laterally from said given path and through said gate openings, and moving the loads progressively upwardly within the trailing portion of the gate opening.

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