A SYSTEM AND METHOD OF HANDLING PIECES OF LUGGAGE

The present invention relates to a system and a method of handling pieces of luggage, and in particular to the interface between a central luggage handling system of an airport and the carts transporting the pieces of luggage between the central luggage handling system and the airplanes.

Relevant technology may be seen in WO2016/177886, US2017/200248, US2018/099751, US6702542 and CN110667877.

In a first aspect, the invention relates to a system according to claim 1.~~for handling pieces of luggage, the system comprising:~~

~~- a delivery system comprising at least one first luggage moving element for transporting a number of pieces of luggage in a first direction,~~

~~- a cart comprising a second luggage moving element having a predetermined length and being positioned so as to receive pieces of luggage from the first luggage moving element, the cart being configured to move in relation to the delivery system so as to transport received luggage,~~

~~- a controller configured to synchronize the speed of the first and second luggage moving elements to control a distance between adjacent pieces of luggage on the second luggage moving element.~~

In the present context, the system may be provided as a number of elements configured to operate together. Preferably, the present system forms part of the luggage handling system of an airport, distribution centre, train station or the like. In the following, the invention will be described primarily transporting pieces of luggage. However, all types of goods, such as products, boxes of products, are equally relevant.

The delivery system may be a central luggage handling system of the airport or the like, which may be configured to handle a large amount of luggage and potentially has multiple delivery systems. The delivery system has at least one first luggage moving element, such as an endless belt, one or more driven rollers, a combination thereof or the like. The delivery system is configured to transport a number of pieces of luggage in a first direction.

A piece of luggage may be any type of luggage, such as a suitcase, but also merchandise and the like packed in boxes. Other types of luggage is sports equipment and other products which are often not packed in suitcases but in special purpose bags. Often, pieces of luggage

such as a vertical plane. Then, the first luggage moving element may have the luggage delivering position and the second luggage moving element may have a luggage receiving portion, which may also be an extreme roller or extreme end of a belt, where the luggage delivering position and the luggage receiving portion are positioned so that luggage may travel along the directions in the plane and from the one moving element to the other. The luggage receiving portion may be at the same height or a lower height than the luggage delivering position.

The system further comprises a controller configured to synchronize the speed of the first and second luggage moving elements to control a distance between adjacent pieces of luggage on the second luggage moving element.

~~In this context, t~~The speed of the second luggage moving element(s) ~~may be~~is a speed relative to a frame of the cart. Usually, the cart will, during synchronization, be stationary vis-à-vis the delivery system, such as a frame of the delivery system.

It is an object of the invention to facilitate automatic transport of the luggage from the first to the second luggage moving element.

An advantage of the luggage moving elements over e.g. chutes is that non-driven luggage transport has a higher probability of the luggage rotating and getting stuck. A challenge with the driven moving elements is that they have a finite length and that continued rotation/movement thereof will make the luggage travel the extent of the moving element and finally may fall therefrom, which is highly problematic.

Naturally, the second luggage moving element may comprise a number of individually driven rollers or belts where a piece of luggage may be received and brought to an end of the second luggage moving element and parked at that position while later received pieces of luggage may be received and parked sequentially along the second luggage moving element. This, however, requires individual controlling of each roller/belt.

In a preferred embodiment, the second luggage moving element is controlled by a single signal so that all luggage on the luggage moving element moves in concert. In one embodiment, the second luggage moving element is formed by a single belt. Alternatively, a number of belts and/or rollers may be used, where all are always moved/rotated at the same time.

The operation of the controller is to ensure that the speeds of the first and second luggage moving elements are synchronized so that a distance between the adjacent pieces of luggage

luggage receiving elements and may be able to, together with the cart, arrive at a desired relative positioning so that the pieces of luggage may be delivered to the receiving station.

The receiving station may then be configured to deliver the pieces of luggage onto or into a carrier, such as an airplane or a luggage receiving portion in an airport.

The same manner of obtaining the relative positioning, using the sensors or any other manner, described above is equally valid in relation to the receiving station.

An interesting technology~~other aspect of the invention~~ relates to a loader/unloader comprising:

- a base,
- a first luggage moving element,
- an actuator configured to move the first luggage moving element relative to the base,
- a sensor for detecting a relative position between the first luggage moving element and a second luggage moving element,
- a controller configured to receive an output of the sensor and activate the actuator to move the first luggage moving element toward the second luggage moving element.

All aspects, technologies, embodiments, situations, and the like described herein may be combined in any desired manner.

This loader/unloader may form part or all of the delivery system or receiving station.

In this respect, the base may be a portion fixed to the ground. Alternatively, the base may be movable, such as if provided with wheels or belts, so that the loader/unloader may move in relation to the surroundings, such as to be positioned in relation to a cart or a carrier, such as an airplane. Naturally, then the loader/unloader may be self-propelled, autonomous, or pulled by a tractor unit.

The actuator may be any type of actuator, such as a pneumatic or hydraulic actuator, an electric motor, a linear actuator, rotating actuator, or the like. Any number of actuators may

be employed, and any type of actuator may be used and any type of power or fuel may be desired for the actuator.

The sensor may be based on any sensor technology. The sensor may be based on vision, such as 2D vision, stereo vision, 3D vision or the like. Alternatively, a radar/lidar/sonar may be used. Other sensor types, such as magnetic sensors, mechanical sensors (push buttons, levers or the like) may be used. The sensor may be configured to determine an angle between the first and second luggage moving elements, such as between predetermined directions thereof, so that the actuator may be operated accordingly. Additionally, or alternatively, the sensor may be configured to determine a distance between the first and second luggage moving elements so that the actuator may be operated accordingly.

The controller may be configured to receive the signal or output of the sensor (multiple sensors may be used) and control the actuator. The controller may be configured to determine an operation of the actuator to bring the first luggage moving element to a first position vis-à-vis the second luggage moving element. In addition, the controller may be configured to output information, such as to the cart, to move in a predetermined manner relative to the base, so that the distance or relative position between the first and second luggage moving elements is adapted.

The loader/unloader may be configured to move the first luggage element vis-à-vis the base. This movement may be in 1, 2 or 3 dimensions.

In addition to the actuator configured to move the first luggage moving element vis-à-vis the base, other actuators may be desired for moving the base in relation to the surroundings, such as if the loader/unloader is self-propelled.

Another interesting technology~~aspect of the invention~~ relates to an assembly of the loader/unloader according to the former aspect of the invention and a cart comprising the second luggage moving element, wherein the controller is configured to output controlling information and the cart is configured to receive the controlling information and control the cart to move so as to bring the second luggage moving element in relation to the first luggage moving element.

In addition, the controller may be configured to output information based on which the second luggage moving element may be moved in relation to e.g. a base or driving portion of the cart. As mentioned above, it may be desired that the cart is able to move in one direction where the first luggage moving element is configured to move in another direction. Then, it may be desired that the second luggage moving element is configured to move in a third direction vis-à-vis the base of the cart.

As mentioned above, the cart and loader/unloader may comprise multiple luggage moving elements where a first luggage moving element is configured to engage or receive luggage from or deliver luggage to a corresponding second luggage moving element.

Naturally, when loading luggage, the loader may be configured to operate as described above.

When unloading luggage from a second luggage moving element, the unloading and thus the operation of the second luggage moving element may be controlled by the unloader.

The unloader may be configured to deliver the received luggage into e.g. a carrier. Alternatively, luggage from e.g. a carrier may be delivered to a luggage handling operation of an airport. The unloader thus unloads the cart and delivers the luggage to this operation. This delivery may represent a bottleneck so that the unloading of the second luggage moving element may be controlled by the capacity or capability of the delivery to the carrier. The first luggage moving element may have a simple detector configured to determine when the first luggage moving element has space for more pieces of luggage, where after a second luggage moving element may be allowed to deliver one or more pieces of luggage to the first luggage moving element.

In one embodiment, the unloader comprises the same number of first luggage moving elements as the number of second luggage moving elements on the cart. If the first luggage moving elements are capable of receiving all pieces of luggage transported on each corresponding second luggage moving element, the cart may be completely unloaded by simultaneously unloading all second luggage moving elements. Then, the cart may immediately thereafter move to another location such as for receiving new pieces of luggage.

Naturally, if multiple first luggage moving elements are provided, the luggage from these elements may be transported via multiple conveyors or may be combined into e.g. one conveyor and then transported to the carrier.

As mentioned above, a particular order may be determined for unloading the cart. This order may be fed to the cart when loading the cart and then to the unloader (or simply via an overall controller) for ensuring the correct order of the pieces of luggage unloaded to the carrier. The unloader thus may be configured to receive information relating to an order of unloading and then unload the pieces of luggage in that order.

Another aspect of the invention relates to a method <u>according to claim 9.</u> ~~of handling pieces of luggage, the method comprising:~~

~~- a first luggage moving element transporting a number of pieces of luggage in a first direction,~~

~~- a second luggage moving element, provided on or at a cart, receiving the pieces of luggage from the first luggage moving element while a controller synchronizes the speed of the first and second luggage moving elements to control a distance between adjacent pieces of luggage on the second luggage moving element,~~

~~- subsequently, the cart moving in relation to the delivery system so as to transport received luggage.~~

Clearly, all aspects, technologies, embodiments, situations, and considerations may be interchanged. All above considerations of the aspects of the invention are equally valid in this respect.

The first luggage moving element may be configured to move the pieces of luggage in a predetermined direction. Often, the first luggage moving element comprises one or more belts or rollers or combinations thereof. Belts/rollers are normally configured to move luggage in one or both of two oppositely directed directions.

The second luggage receiving element usually would be positioned in the first direction in relation to the first luggage moving element, such as at an end of the first luggage moving element so that luggage leaving the first luggage moving element will be delivered on or to the second luggage moving element.

The first luggage moving element may be configured to transport any number of pieces of luggage. Often, the pieces of luggage are transported sequentially.

The controller synchronizes the speed of the first and second luggage moving elements as described above so that a distance between the pieces of luggage on the second luggage moving element is as desired. As mentioned above, it may be desired that this distance is not too large.

After being loaded, the cart will be moving so as to transport the luggage.

In one embodiment, the controller controls the movement of the second luggage moving element so that the second luggage moving element does not move when the first luggage moving element moves if no luggage is transferred from the first to the second luggage moving element. Then, the first luggage moving element may be allowed to move as long as no luggage is transported thereby.

In one embodiment, the controller controls the second luggage moving element to move at a lower speed than a speed with which the first luggage moving element moves. This is especially relevant when luggage is transferred between the first and second luggage moving elements, as this will decrease any distance between the luggage transferred and previously received luggage.

In one embodiment, the controller brakes the second luggage moving element when luggage is transferred from the first luggage moving element to the second luggage moving element. As mentioned above, the second luggage moving element may then be pushed or driven by the first luggage moving element via the luggage being transferred.

In one embodiment, the synchronizing step comprises a first detector detecting luggage at or on the first luggage moving element. This detector may be positioned at any position of the first luggage moving element. Often, when the position of a piece of luggage is known at one point in time, the position may be estimated at future points in time when the movement of the moving element is known.

In one embodiment, the synchronizing step comprises a second detector detecting presence and/or a position of one or more pieces of luggage on the second luggage moving element. This detection may be used for ascertaining that the luggage has been transferred or for determining when a second luggage moving element is full.

In one embodiment, the controller controls the first and second luggage moving elements to obtain a distance between adjacent pieces of luggage no more than 10cm, such as no more than 5cm.

In one embodiment, prior the transporting step, the cart moves, relative to a predetermined coordinate system, such as the earth, in one direction along a first axis and the delivery system, such as the first luggage moving element, moves in another direction along another axis not parallel to the first axis. Thus, the relative positioning of the first and second luggage moving elements prior to the luggage hand-over may be obtained using not only one but both of the cart and the delivery system or first luggage moving element.

Another interesting technology~~aspect of the invention~~ relates to a method of operating a loader/unloader, such as a loader/unloader as described above, the loader/unloader comprising:

- a base,

- a first luggage moving element, and

CLAIMS

1. A system (10) for handling pieces of luggage (36), the system comprising:

- a delivery system (22) comprising at least one first luggage moving element (221) for transporting a number of pieces of luggage in a first direction,

- a cart (30) comprising a frame and a second luggage moving element (321) having a predetermined length and being positioned so as to receive pieces of luggage from the first luggage moving element, the cart being configured to move in relation to the delivery system so as to transport received luggage, and

- a controller (90),

characterized in that the controller is configured to synchronize the speed of the first luggage moving element and the speed of the second luggage moving elements, relative to the frame, to control a distance between adjacent pieces of luggage on the second luggage moving element.

2. A system according to claim 1, wherein the controller is configured to control the movement of the second luggage moving element so that the second luggage moving element does not move when the first luggage moving element moves and where no luggage is transferred from the first to the second luggage moving element.

3. A system according to any of the preceding claims, wherein the controller is configured to control the second luggage moving element to move at a lower speed than a speed with which the first luggage moving element moves.

4. A system according to any of the preceding claims, wherein the controller is configured to brake the second luggage moving element when luggage is transferred from the first luggage moving element to the second luggage moving element.

5. A system according to any of the preceding claims, wherein the delivery system comprises a first detector (12) configured to detect luggage.

6. A system according to any of the preceding claims, wherein the cart comprises a second detector (13) configured to detect presence and/or a position of one or more pieces of luggage on the second luggage moving element.

7. A system according to any of the preceding claims, wherein the controller is configured to control the first and second luggage moving elements to obtain a distance between adjacent pieces of luggage no more than 10cm.

8. A system according to any of the preceding claims, wherein the cart is configured to move, relative to a predetermined coordinate system in one direction along a first axis and the delivery system is configured to move in another direction along another axis not parallel to the first axis.

~~9. A loader/unloader comprising:~~

~~- a base,~~

~~- a first luggage moving element,~~

~~- an actuator configured to move the first luggage moving element relative to the base,~~

~~- a sensor for detecting a relative position between the first luggage moving element and a second luggage moving element,~~

~~- a controller configured to receive an output of the sensor and activate the actuator to move the first luggage moving element toward the second luggage moving element.~~

~~10. An assembly of the loader/unloader according to claim 9 and a cart comprising the second luggage moving element, wherein the controller is configured to output controlling information and the cart is configured to receive the controlling information and control the cart to move so as to bring the second luggage moving element toward the first luggage moving element.~~

~~11~~9. A method of handling pieces of luggage, the method comprising:

- a first luggage moving element<u>, of a delivery system,</u> transporting a number of pieces of luggage in a first direction,

- a second luggage moving element, provided on or at a cart <u>with a frame</u>, receiving the pieces of luggage from the first luggage moving element<u>,</u>

- subsequently, the cart moving in relation to the delivery system so as to transport received luggage,

characterized in that the step of the second luggage moving element receiving the pieces of luggage from the first luggage moving element is performed while a controller synchronizes the speed of the first moving element and the speed of the second luggage moving elements, relative to the frame, to control a distance between adjacent pieces of luggage on the second luggage moving element,

~~- subsequently, the cart moving in relation to the delivery system so as to transport received luggage~~.

~~12~~10. A method according to claim ~~11~~9, wherein the controller controls the movement of the second luggage moving element so that the second luggage moving element does not move when the first luggage moving element moves and where no luggage is transferred from the first to the second luggage moving element.

~~13~~11. A method according to claim ~~11~~ 9 or ~~12~~10, wherein the controller controls the second luggage moving element to move at a lower speed than a speed with which the first luggage moving element moves.

~~14~~12. A method according to any of claims ~~11~~9-~~13~~11, wherein the controller brakes the second luggage moving element when luggage is transferred from the first luggage moving element to the second luggage moving element.

~~15~~13. A method according to any of claims ~~11~~9-~~14~~12, wherein the synchronizing step comprises a first detector detecting luggage at or on the first luggage moving element.

~~16~~14. A method according to any of claims ~~11~~9-~~15~~13, wherein the synchronizing step comprises a second detector detecting presence and/or a position of one or more pieces of luggage on the second luggage moving element.

~~17~~15. A method according to any of claims ~~11~~9-~~16~~14, wherein the controller controls the first and second luggage moving elements to obtain a distance between adjacent pieces of luggage no more than 10cm.

~~18. A method according to any of claims 11-17, wherein, prior the transporting step, the cart moves, relative to a predetermined coordinate system in one direction along a first~~

~~axis and the delivery system moves in another direction along another axis not parallel to the first axis.~~

~~19. A method of operating a loader/unloader comprising:~~

- ~~a base,~~
- ~~a first luggage moving element, and~~
- ~~a sensor,~~

~~the method comprising:~~

- ~~the sensor for detecting a relative position between the first luggage moving element and a second luggage moving element and~~
- ~~moving the first luggage moving element toward the second luggage moving element.~~

~~20. A method according to claim 19, where the second luggage moving element is provided on a cart, the method further comprising the step of the loader/unloader outputting controlling information and the cart receiving the controlling information and the cart moving so as to bring the second luggage moving element toward the first luggage moving element.~~