

## RAIL TRANSPORT SYSTEM

The present invention is related to a rail transport system, in particular a rail transport system for the loading and unloading of cargo, such as carriages for an aircraft.

European patent EP 2627597 B1 describes a rail transport system for the loading and unloading of an aircraft galley. The transport system consists of two shaped profile guide rails, a transport rail and a trolley, wherein the trolley is loaded with carriages and moved on the transport rail. In addition, the patent also shows a system for the simultaneous loading of an aircraft galley which includes a truck bed, two rail transport systems between the truck bed and the aircraft cabin and a plurality of rail traffic systems on the truck bed, for transport of the trolley within the truck bed. However, the transport rails described in EP 2627597 B1 allow the trolley to move in only one direction back and forth.

From US Patent 4,824,050 a device is already known by which a secure fixing of the cargo in the hold of an aircraft is made possible. A rail system for displacement of a trolley on a truck bed and subsequent transfer into an aircraft galley is not provided there.

German unexamined patent application DE 197 56 551 A1 cites a loading and unloading system for trucks which also allows sorting of loaded containers en route, so that the cargo can be unloaded in a time-saving manner even in the event of a rescheduling by the customer.

Furthermore, German utility model DE 200 16 115 U1 provides for a modular couplable loading floor for trucks, wherein a plurality of loading floors can be combined to form a transport path. A rail transport system that allows a displacement of a trolley on a truck bed and its subsequent transfer into an aircraft galley is not provided there.

The object of the present invention is to provide a rail transport system which enables the trolley to move not only in a longitudinal direction back and

forth, but also in a lateral direction, which provides more flexibility for the transport of cargo.

The rail transport system according to the present invention comprises at least one section for the loading/unloading position on each side of the transport system, a transport section and a trolley. Each loading/unloading section comprises a plurality of bi-directional loading/unloading modules, wherein each bi-directional loading/unloading module comprises at least two longitudinal profile guide rails and at least two lateral profile guide rails. The bi-directional loading/unloading modules are interconnected so that the lateral profile guide rails of a bi-directional module are connected to the transverse profile guide rails of the adjacent bi-directional module or modules. The trolley is moved along the guide rails.

Each of the bi-directional loading/unloading modules has at least two shaped profile guide rails, which are positioned parallel to each other and in the longitudinal direction, and at least two shaped profile guide rails, which are positioned parallel to each other and in the transverse direction. The term "bi-directional" means that at least two sets of guide rails in the loading/unloading position extend in two different directions and these two directions are preferably perpendicular to each other, namely one direction extends longitudinally and one direction extends transversely. In this way, the trolley can move both along the longitudinal direction and along the transverse direction.

The bi-directional loading/unloading modules are arranged side by side and can be connected together with screws. The bi-directional loading/unloading modules are interconnected so that the lateral profile guide rails of a bi-directional module are connected to the transverse profile guide rails of the adjacent bi-directional module or modules. In this way, the trolleys can be moved laterally so that they can be arranged first on the longitudinal guide rails, along which they are transported. This is one of the advantages of the present invention, since the lateral position of each trolley, according to the present invention, can be adjusted, before the carriage is moved along the longitudinal direction.

Preferably, each loading/unloading section contains two or more rows of the bi-directional loading/unloading modules, where each bi-directional loading/unloading module is connected to the adjacent bi-directional loading/unloading module of the adjacent row, so that the longitudinal profile guide rails of a loading/unloading module are connected to the longitudinal profile guide rails of the adjacent bi-directional module. The present invention lends the transport of the carriages more flexibility. The trolleys can be moved in the lateral direction and are initially positioned in the desired longitudinal guide rails, before they are transported into the transport area. Before being unloaded, they can also be aligned in the desired longitudinal position corresponding to the loading/unloading ramp, so that they can be unloaded easily via the loading/unloading ramp.

Preferably, each bi-directional loading/unloading module also includes at least one gear that rotates along the width direction, and at least one gear that rotates along the lateral direction. In addition, each bi-directional loading/unloading module contains one motor which drives the gear along the width direction, and one motor which drives the gear along the longitudinal direction. By switching on and off the motors, the trolley can be moved in a controlled manner in both directions.

Also, each unidirectional transport module also preferably includes at least one electric motor and at least one gear that rotates along the longitudinal direction to allow the movement of the trolley in the longitudinal direction.

The trolley of the present invention comprises a panel for the transport of carriages. For the trolley of the present invention, it is important to have gear racks on the underside of the panel. The gear racks are arranged to correspond to the gears of the bi-directional and unidirectional modules so that the trolley can be driven by the motor and the gear, to be moved either along the longitudinal or the transverse direction.

Preferably, the rail transport system also comprises a loading ramp, where the loading ramp includes at least two bi-directional loading/unloading modules and the loading ramp is connected to the loading/unloading section in such a way that

the longitudinal profile guide rails of each module are connected to the longitudinal profile guide rails of the adjacent bi-directional loading/unloading module. Preferably, each of the bi-directional loading/unloading modules also includes at least one electric motor and at least one gear along the width direction and at least one gear along the longitudinal direction to allow the movement of the trolley in both directions.

Preferably, the foldable loading ramp is connected to the bi-directional loading/unloading module of the loading/unloading section and can be unfolded when used for loading and unloading.

The rail transport system can be used in a plurality of scenarios. It can be used in a warehouse, a truck bed, etc. When used for loading in the forward direction and unloading in the reverse direction of forklift boxes, a loading ramp is required. The loading ramp is used to load or unload the trolley. The loading ramp preferably comprises only two bi-directional loading/unloading modules. Since the trolley can move laterally due to the presence of both transverse and longitudinal guide rails in the loading/unloading section, the trolley can be guided accurately to the loading ramp for unloading or the trolley can be led away laterally to make room for the loading of the next carriage, which provides a tremendous advantage and flexibility.

Preferably, all of the shaped profile guide rails of the present invention are U-shaped guide rails having an open upper portion, which is covered from both sides. This particular form of guide rails stabilises the trolley during transportation and prevents the trolley from tipping over.

Preferably, each loading/unloading module and each transport module is covered with a panel for protecting the electric motor, wherein the panel is provided with openings to expose the corresponding gears.

Preferably, each unidirectional transport module on the transport section of the rail transport system of the present invention comprises a plurality of rail

segments. On a transport rail, which consists of a plurality of rail segments, two adjacent rail segments are preferably connected by a swivel which makes it possible to fold the transport rail together. On a telescopic transport rail, which consists of a plurality of rail segments, the transport rail has a telescopic device, which is operated by the electric motor. The rail segments are interconnected in a telescopic manner and the telescopic device is able to push the transport rails, segment by segment, by using a transmission mechanism.

The electric motor of the rail transport system of the present invention can in each case be operated by a battery. The rechargeable battery can be recharged by the generator on the truck/forklift.

#### **FIGURES:**

- |          |                                                                                                                                                                              |
|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Figure 1 | is a plan view of the rail transport system of the present invention.                                                                                                        |
| Figure 2 | is a plan view of a bi-directional loading/unloading module of the present invention, without motors and gears.                                                              |
| Figure 3 | is a plan view of the bi-directional loading/unloading module in Figure 2, provided with a motor and gears in the longitudinal direction.                                    |
| Figure 4 | is a plan view of the bi-directional loading/unloading module in Figure 3, also provided with a motor and gears in the lateral direction.                                    |
| Figure 5 | is a plan view of the bi-directional loading/unloading module in Figure 4, wherein the module is covered with a panel with openings in order to expose the respective gears. |
| Figure 6 | shows the bi-directional loading/unloading modules in Figure 5 grouped together in order to form the loading/unloading section of the present invention.                     |

|                                |                                                                                                                                   |
|--------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|
| Figure 7.1                     | shows the bottom view of the drive unit of the bi-directional loading/unloading module in the longitudinal direction in Figure 4. |
| Figure 7.2                     | shows the side view of the gear in Figure 8.                                                                                      |
| Figure 8                       | shows the loading ramp of the rail transport system of the present invention.                                                     |
| Figure 9                       | shows the side view of the floor panel of the trolley.                                                                            |
| Figure 10.1 and<br>Figure 10.2 | show the trolley when transporting carriages onto the rail transport system of the present invention.                             |
| Figure 11                      | shows one of the applications of the rail transport system of the present invention.                                              |

#### **List of Reference Numerals:**

|              |                                                                                |
|--------------|--------------------------------------------------------------------------------|
| <b>1, 2:</b> | loading/unloading section                                                      |
| <b>3:</b>    | transport section                                                              |
| <b>4, 5:</b> | bi-directional loading/unloading module                                        |
| <b>6:</b>    | unidirectional transport module                                                |
| <b>7:</b>    | longitudinal profile guide rail of the bi-directional loading/unloading module |
| <b>8:</b>    | lateral profile guide rail of the bi-directional loading/unloading module      |
| <b>9:</b>    | gears in the longitudinal direction                                            |
| <b>10:</b>   | transmission gear                                                              |
| <b>11:</b>   | gears in the lateral direction                                                 |
| <b>12:</b>   | motor for gears in the longitudinal direction                                  |
| <b>13:</b>   | drive gears                                                                    |
| <b>14:</b>   | covering panel                                                                 |
| <b>15:</b>   | longitudinal profile guide rail of the unidirectional transport module         |
| <b>16:</b>   | motor for gears in the lateral direction                                       |
| <b>17:</b>   | floor panel of the trolley                                                     |

- 18:** intersection of two gear rails in the longitudinal and transverse direction
- 19:** loading ramp
- 20:** carriage
- 21:** trolley
- 22:** truck box
- 23:** gear racks

#### **TYPES OF EMBODIMENT:**

Further advantages and details of the present invention are illustrated as follows, based on the embodiments as illustrated in the drawings, which in no way limit the scope of protection of the invention.

Figure 1 is a plan view of the rail transport system of the present invention. The rail transport system comprises on each side a loading/unloading section **1, 2**, a transport section **3** and a loading ramp **19**. Each loading/unloading section **1, 2** comprises in each case a plurality of bi-directional loading/unloading modules **4, 5**. The transport section comprises a plurality of unidirectional transport modules **6**. Each bi-directional loading/unloading module comprises at least two longitudinal profile guide rails and at least two transversal profile guide rails, wherein the bi-directional loading/unloading modules are interconnected so that the transversal profile guide rails of one bi-directional module are connected to the transversal profile guide rails of the adjacent bi-directional module/modules. Each transport module contains two longitudinal profile guide rails, and wherein each unidirectional transport module is connected to a loading/unloading module on each side of the transport system so that the longitudinal profile guide rails of the transport module are connected to the adjacent longitudinal profile guide rails of the loading/unloading modules.

Figure 2 is a plan view of a bi-directional loading/unloading module of the present invention, without motors and gears. Each bi-directional loading/unloading module comprises at least two longitudinal profile guide rails **7** and at least two

transversal profile guide rails **8**.

Figure 3 is a plan view of the bi-directional loading/unloading module in Figure 2, provided with a motor (not clearly illustrated) and gears **9** in the longitudinal direction. The transmission gear **10** increases the torque and regulates the rotational speed of the gears.

Figure 4 is a plan view of the bi-directional loading/unloading module in Figure 3, also provided with a motor **12** and gears **11** in the lateral direction. The motor **12** drives the gears **11** through the drive gears **13** of the axes.

Figure 5 is a plan view of the bi-directional loading/unloading module in Figure 4, wherein the module is covered with a panel **14** with openings, in order to expose the respective gears **9**, **11** and drive gears **13**.

Figure 6 shows the bi-directional loading/unloading modules **4** in Figure 5 grouped together in order to form the loading/unloading section of the present invention.

Figure 7.1 shows the bottom view of the drive unit of the bi-directional loading/unloading module in the longitudinal direction in Figure 4. The module contains gears **9**, a motor **16** and transmission gears **10**.

Figure 7.2 shows the side view of the gear **9** in Figure 7.1.

Figure 8 shows the loading ramp of the rail transport system of the present invention. The loading ramp is assembled from at least two bi-directional loading/unloading modules **4**, wherein each of the bi-directional loading/unloading modules **4** also comprises two electric motors (not shown) and a set of gears along the longitudinal direction **9** and at least one gear along the transverse direction **11**, to enable the movement of the trolley in both directions. Each bi-directional loading/unloading module comprises at least two longitudinal profile guide rails **7** and at least two transversal profile guide rails **8**, wherein the bi-directional loading/unloading modules are interconnected so that the transversal profile guide

rails **8** of one bi-directional module are connected to the transversal profile guide rails **8** of the adjacent bi-directional module/modules. Each module is covered with a panel with openings, to expose the respective gears **9**, **11** and drive gears **13**.

Figure 9 shows the side view of the floor panel **17** of the trolley. The underside of the floor panel **17** of the trolley is provided with gear racks **23**, which are positioned so that they fit together with the gears of the bi-directional and unidirectional modules. The figure also shows intersections **18** of two gear rails in the longitudinal and transverse direction.

Figures 10.1 and 10.2 show the trolley **21** when transporting carriages **20** onto the rail transport system of the present invention. Each unidirectional transport module **6** is connected to a loading/unloading module **4**, **5** on each side of the transport system in such a way that the longitudinal profile guide rails **15** of the transport module are connected to the adjacent longitudinal profile guide rails **7** of the respective loading/unloading modules in each case, so that the trolley **21** can be moved between the loading/unloading section and the transport area in the longitudinal direction.

Figure 11 shows how the rail transport system of the present invention is used for the loading and unloading of a truck box **22** with carriages. The loading ramp **19** consists of at least two bi-directional loading/unloading modules and the loading ramp **19** is connected to the loading/unloading section in such a way that the longitudinal profile guide rails of each module are connected to the longitudinal profile guide rails of the adjacent bi-directional loading/unloading module, so that the trolley can be loaded onto and from the truck.

**Claims:**

1. A rail transport system that contains at least the following components:
  - A loading/unloading section (1, 2) on each side of the transport system, in which each loading/unloading section in each case comprises a plurality of bi-directional loading/unloading modules (4), wherein each bi-directional loading/unloading module comprises at least two longitudinal profile guide rails (7) and at least two transversal profile guide rails (8), wherein the bi-directional loading/unloading modules (4) are interconnected, so that the transversal profile guide rails (8) of one bi-directional module are connected to the transversal profile guide rails (8) of the adjacent bi-directional module (modules);
  - A transport section (3), wherein the transport section (3) comprises a plurality of unidirectional transport modules (6), wherein each transport module (6) has two longitudinal profile guide rails (15), and wherein each unidirectional transport module (6) is connected to a loading/unloading module (4, 5) on each side of the transport system in such a way that the longitudinal profile guide rails (15) of the transport module (6) are each connected to the adjacent longitudinal profile guide rails (7) of the loading/unloading modules (4, 5); and
  - a trolley (21), which is moved along the guide rails.
2. A transport system according to claim 1, characterised in that each loading/unloading section (1, 2) contains two or more rows of the bi-directional loading/unloading modules (4, 5), where each bi-directional loading/unloading module (4, 5) is connected to the adjacent bi-directional loading/unloading module (4, 5) of the adjacent row, so that the longitudinal profile guide rails (7) of one of the loading/unloading modules (4, 5) are connected to the longitudinal profile guide rails (7) of the adjacent bi-directional module (modules) (4, 5).
3. The rail transport system according to claim 1 or 2, characterised in that each bi-directional loading/unloading module (4, 5) also has at least one electric

motor (12, 16) and at least one gear along the longitudinal direction (9) and at least one gear along the transverse direction (11), to enable the trolley (21) to move in both directions.

4. The rail transport system according to claims 1 to 3, characterised in that each unidirectional transport module (6) also comprises at least one electric motor and at least one gear along the longitudinal direction, to enable the trolley (21) to move in the longitudinal direction.
5. The rail transport system according to any one of claims 1 to 4, characterised in that the rail transport system also comprises a loading ramp (19), wherein the loading ramp (19) consists of at least two bi-directional loading/unloading modules and is connected to the loading/unloading section (2) in such a way that the longitudinal profile guide rails (7) of each module are connected to the longitudinal profile guide rails (7) of the adjacent bi-directional loading/unloading module, wherein each of the bi-directional loading/unloading modules also comprises at least one electric motor (12, 16) and at least one gear along the longitudinal direction (9) and at least one gear along the transverse direction (11), to enable the movement of the trolley (21) in both directions.
6. The rail transport system according to claim 5, characterised in that the loading ramp (19), which is connected to the bi-directional loading/unloading module of the loading/unloading section (2), is hinged and can be unfolded in use during the loading/unloading.
7. The rail transport system according to claims 1 or 6, characterised in that all shaped profile guide rails are U-shaped guide rails (7, 8, 15), wherein the upper portion is partially covered from both sides.
8. The rail transport system according to claims 1 to 7, characterised in that each loading/unloading module (4, 5) and each transport module (6) is covered with a panel (14), to protect the electric motors (12, 16), wherein the panel is

provided with openings, to expose the corresponding gears.

9. The rail transport system according to claims 1 to 8, characterised in that the trolley (21) has a panel (17) for supporting the carriages, wherein the underside of the panel (17) is provided with gear racks (23), which are positioned so that they correspond to the gears of the bi-directional (4, 5) and unidirectional modules (6).
10. The rail transport system according to claims 1 to 9, characterised in that each unidirectional transport module (6) comprises a plurality of foldable rail cassettes or a telescopic rail segment.