

Method and Apparatus for Coupling an Automated Load Transporter to a Moveable Load

Field of the Invention

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The present invention relates to a method and apparatus for coupling an Automated Load Transporter to a Moveable Load, in particular, for automated connection of an Automated Guided Vehicle or Robot to a moveable load platform.

Background

Automated Load Transporters, for instance, automated guided vehicles (AGV) are used in a variety of industrial environments, including warehouses, factories and hospitals. They move automatically from one location to another, generally following a guided path or track mapped via artificial intelligence. They are intended to efficiently transport materials from location to location without requiring a vehicle driver.

During transportation, AGVs generally pull moveable loads, which may be in the form of trailers or trolleys on which goods to be transported are placed. Trailers or trolleys are coupled to the AGV, usually on their rears through couplings. However, the connection between the couplings is usually not sufficiently firm and only enables the AGV to pull the trailers or trolleys. Generally, AGVs are programmed to stop at particular locations to automatically pick up trailers or trolleys and move them to other locations. However, if the AGV fails to pick up the trailer or trolley, which is often due to misalignment between the AGV and the trailer or trolley, or in situations where the AGV pulling a trailer or trolley reaches a dead end and there is insufficient space for the AGV to make a U-turn, the AGV operation will fail. When this happens, the AGV needs to be rerouted (reprogrammed) through the facility, which diminishes the AGV system's productivity and worker efficiency.

To solve the misalignment problem, there is a proposed solution of allowing the automatic coupling between the AGV and the trailer or trolley to be done with a significant run-in distance by the AGV. However, due to space constraint in storage facilities, this may not be a practical solution. Another proposed solution is to allow the AGV to reach under the trailer or trolley to lift it up. This requires the trailer or trolley to be customized to fit this type of lifting method by the AGV and hence is not suitable for applications that wish to reuse their existing trailers or trolleys.

Summary

According to one aspect of an example of the present invention, there is provided an apparatus for coupling an Automated Load Transporter to a moveable load, the apparatus comprising: an interlocking member for coupling with an opening in a receiving member, the interlocking member having a tapered shape with a cross-sectional area having at least two edges, wherein the interlocking member is mounted on the Automated Load Transporter and the receiving member is mounted on the moveable load, or the interlocking member is mounted on the moveable load and the receiving member is mounted on the Automated Load Transporter; wherein the opening has a corresponding tapered shape and cross-sectional area for receiving the tapered shape of the interlocking member.

According to another aspect of an example of the present invention, there is provided a method for coupling an Automated Load Transporter to a moveable load, the method comprising: detecting a position of a moveable load and a position of an Automated Load Transporter; processing position data of the Automated Load Transporter and the moveable load for determining alignment position of the Automated Load Transporter and the moveable load so as to enable an interlocking member to couple with a receiving member, the interlocking member having a tapered shape with a cross-sectional area having at least two edges, wherein the interlocking member is mounted on the Automated Load Transporter and the receiving member is mounted on the moveable load, or the interlocking member is mounted on the moveable load and the receiving member is mounted on the Automated Load Transporter; and moving the interlocking member in a direction to couple with an opening in the receiving member or moving the receiving member having the opening in a direction to couple with the interlocking member, wherein the opening has a corresponding tapered shape and cross-sectional area for receiving the tapered shape of the interlocking member.

Brief Description of the Drawings

Embodiments of the method and the apparatus will now be described with reference to the accompanying figures in which:

Fig. 1A is a perspective view of an example of an assembly of an Automated Load Transporter.

Fig. 1B shows an example of an apparatus for coupling the Automated Load Transporter to a movable load.

Fig. 1C is a zoom-up view of an interlocking member of the apparatus.

Fig. 1D is a zoom-up view of a receiving member of the apparatus.

Fig. 2 is a perspective view of an example of an assembly of the Automated Load Transporter when coupled to a movable load.

Figs. 3A to 3N illustrate examples of cross-sectional areas of the interlocking member of the apparatus.

Fig. 4 shows an example of the components of a processing unit of the apparatus.

Detailed Description

Fig. 1A illustrates a perspective view of an exemplary Automated Load Transporter 100 that includes an interlocking member 102 that has a tapered shape of a truncated pyramid where the cross-sectional area of the truncated pyramid is rectangular or squarish with round edges, a sensor 104 for obtaining sensor data and an actuator 106 for moving the interlocking member 102 in an upwards or downwards direction.

Fig. 1B shows an example of an apparatus for coupling the Automated Load Transporter 100 to a movable load 200. The apparatus comprises the interlocking member 102 for coupling with a receiving member 202, where the interlocking member 102 has a tapered shape with a cross-sectional area having at least two edges. The at least two edges may be rounded edges as shown in Fig. 1B, or in other cases, sharp edges. The interlocking member 102 is mounted on the Automated Load Transporter 100 and the receiving member 202 is mounted on the moveable load 200. It is appreciated that in a different example, the interlocking member 102 may be mounted on the moveable load 200 and the receiving member 202 may be mounted on the Automated Load Transporter 100.

The apparatus further comprises the actuator 106 for moving the interlocking member 102 in a direction to couple with an opening 204 in the receiving member 200, where the opening 204 has a corresponding tapered shape and cross-sectional area for receiving the tapered shape of the interlocking member 102. A zoom-in view of the receiving

member 202 that is deliberately made transparent or see through is shown in Fig. 1B to illustrate that the opening 204 has a corresponding tapered shape and cross-sectional area for receiving the tapered shape of the interlocking member 102.

- 5 The apparatus also comprises at least one sensor 104, in this case only one is shown, configured for detecting a position of the moveable load 200 and a position of the Automated Load Transporter 100. The at least one sensor 104 may include camera, infrared sensor, laser sensor, and the like.
- 10 The apparatus also comprises a processing unit 108 for processing position data of the Automated Load Transporter 100 and the moveable load 200 for determining alignment position of the Automated Load Transporter 100 and the moveable load 200 so as to enable the interlocking member 102 to couple with the receiving member 202.
- 15 The moveable load 200 may be a trolley or trailer, in which the trolley or trailer is configured to carry goods placed thereon.

Fig. 2 illustrates a perspective view of an example of the Automated Load Transporter 100 coupled to a movable load 200 in a coupling position. In the coupling position, the

20 interlocking member 102 of the Automated Load Transporter 100 is coupled to the receiving member 202 of the movable load 200. The receiving member 202 has an opening 204 for receiving the interlocking member 102. The opening 204 in the receiving member 202 has a corresponding tapered shape of a pyramid as the interlocking member 102 to allow the interlocking member 102 as shown in Fig. 1C to fit into the receiving

25 member 202 as shown in Fig. 1D. Advantageously, the purpose of the tapered shape of the interlocking member 102 is to allow more tolerance during the coupling between the interlocking member 102 and receiving member 202 yet resulting in a rigid or firm joint between the interlocking member 102 and receiving member 202. With reference to Figures 1B, 1C, 1D and 2, it is possible to have more tolerance during the coupling

30 because the narrower part of the interlocking member 102 which is the top portion 110 of the truncated pyramid will first enter a larger part 206 of the opening 204 located at the bottom of the receiving member 202. The larger part is larger because it is shaped corresponding to receive the shape of the truncated pyramid.

- 35 The pyramidal shape of the interlocking member 102 which has the cross-sectional area of the square or rectangle will have edges at the 4 corners to prevent the interlocking member 102 from rotating in the opening 204 of the receiving member 202 when the

interlocking member 102 and receiving member 202 are in the coupling position. The edges at the 4 corners may be sharp or rounded edges. This provides the rigid or firm joint between the interlocking member 102 and the receiving member 202, which will allow not just pulling but also pushing of the movable load 200 by the Automated Load Transporter 100. As described in the background section, it is appreciated that pushing is currently not possible in existing automated guided vehicles, which are a type of the Automated Load Transporter 100 described herein. The rigid or firm joint will be hard to achieve, if achievable at all, if the interlocking member 102 has a cylindrical or conical shape with no edges. Typically, in existing implementations, a swivel joint attachment is used and it is only suitable for pulling but not pushing. The rigid or firm joint discussed herein also advantageously enables the Automated Load Transporter 100 that is pulling the movable load 200 and moving in a direction towards a dead end corner to escape from such a deadlock situation. This is regarded as a deadlock situation because in existing implementations, an automated guided vehicle will have to make a U-turn while pulling the movable load, which is not possible in most environments the automated guided vehicle may be deployed, such as in a warehouse where space is valuable and limited. If such deadlock situation arises, the Automated Load Transporter 100 discussed herein will move in an opposite direction by pushing the movable load 200 instead of making the U-turn.

Other than the pyramidal shape with the cross-sectional area of the square or rectangle as described previously, the interlocking member 102 as described with reference to Figures 1 and 2 may be in other tapered shapes having different cross-sectional areas as illustrated in Figs. 3A to 3N. An edge described herein refers to a sharp or rounded extension of the cross-sectional area of the interlocking member 102 or protrusion from the cross-sectional area of the interlocking member 102 that would prevent rotation of the interlocking member 102 about an axis orthogonal to the cross-sectional area of the interlocking member 102 when the interlocking member 102 is coupled to the receiving member 202 having a corresponding fitting shape for receiving the interlocking member 102. It is appreciated that in other examples, a cross-sectional area with at least one straight side or at least one substantially straight side will also work. Also, a cross-sectional area with an elongate body may also work.

Fig. 3A shows a parallelogram with 4 edges and 4 straight sides. Fig. 3B shows a trapezium with 4 edges and 4 straight sides. Fig. 3C shows a triangle with 3 edges and 3 straight sides. Fig. 3D shows two semi-circular sides and two straight sides with 4 edges. Fig. 3E shows a crescent shape having two edges. Fig. 3F shows a substantially elliptical

or lip shaped or eye shaped having two sharp edges. Fig. 3G shows a hexagon with 6 edges and 6 straight sides. Fig. 3H shows a cross sign with 12 edges and 12 straight sides. Fig. 3I shows a square with inward curved corners having 8 edges and 4 straight sides. Fig. 3J shows an elongate strip with 2 rounded edges and 2 straight sides. Fig. 3K shows a rectangle with rounded corners having 4 edges and 4 straight sides. Fig. 3L shows a square with rounded corners having 4 edges and 4 straight sides. Fig. 3M shows a teardrop shape with one round edge, one sharp edge and two straight sides. Fig. 3N shows an oval shape having an elongate body with two rounded edges. Both the tapered shape and the cross-sectional area define the shape of the interlocking member 102.

Since the interlocking member 102 has to be fitted into the opening 204 of the receiving member 202, the opening 204 will have a corresponding tapered shape that will enable the receiving member 202 to receive the interlocking member 102.

Fig. 4 shows in detail an example of the processing unit 108 in Fig. 1B for processing position data of the Automated Load Transporter 100 and the moveable load 200 for determining alignment position of the Automated Load Transporter 100 and the moveable load 200 so as to enable the interlocking member 102 to couple with the receiving member 202. The processing unit 108 may include user input modules such as a computer mouse 336, keyboard/keypad 304, and/or a plurality of output devices such as a display 308. The display 308 may be a touch screen capable of receiving user input as well. It is appreciated that in another example, another display (not shown) like the display 308 may be included.

The processing unit 108 may be connected to a computer network 312 via a suitable transceiver device 314 (i.e. a network interface), to enable access to e.g. the Internet or other network systems such as a wired Local Area Network (LAN) or Wide Area Network (WAN). Optionally, the processing unit 108 may be connected to one or more external wireless communication enabled devices 334 via a suitable wireless transceiver device 332 e.g. a WiFi transceiver, Bluetooth module, Mobile telecommunication transceiver suitable for Global System for Mobile Communication (GSM), 3G, 3.5G, 4G telecommunication systems, and the like. Through the computer network 312, the processing unit 108 can gain access to one or more storages i.e. data storages, databases, data servers and the like connectable to the computer network 312 to retrieve and/or store data in the one or more storages.

The processing unit 108 may include a processor integrated circuit 318, a Random Access Memory (RAM) 320 and a Read Only Memory (ROM) 322. The processing unit

108 may also include a number of Input/Output (I/O) interfaces, for example I/O interface 338 to the computer mouse 336, a memory card, flash memory or a hard disk drive 316, I/O interface 324 to the display 308, and I/O interface 326 to the keyboard/keypad 304.

- 5 The components of the processing unit 108 typically communicate via an interconnected bus 328 and in a manner known to the person skilled in the relevant art.

Below is an example showing how the interlocking member 102 of the Automated Load Transporter 100 as described with reference to Figures 1A, 1B, 1C, 1D and 2 is being
10 coupled to the receiving member 202 of the movable load 200.

Step 1: The Automated Load Transporter 100 needs to locate the movable load 200 via a process called map localization, which basically locates the movable load 200 on a predetermined map stored in a memory accessible by the processing unit 108, and upon
15 locating the movable load 200, the Automated Load Transporter 100 will navigate to the vicinity of the movable load 200 and stops at a first position.

Step 2: The Automated Load Transporter 100 will move from the first position into close proximity to the movable load 200 by using at least one sensor 104 such as a camera that
20 is installed on the Automated Load Transporter 100 to detect the movable load 200 and stops at a second position. Other sensors that can provide the distance or bearing information between the Automated Load Transporter 100 and movable load 200 may also be used. For instance, a Global positioning system (GPS) unit can be one such sensor. It is appreciated that more than one sensors may be at work to enable the
25 Automated Load Transporter 100 to make routing decisions and execute automated movements via artificial intelligence technologies that is integrated with the Automated Load Transporter 100. The processing involved for the routing decisions can be performed by the processing unit 108. It is appreciated that the camera may be an optical instrument for recording images, which may be stored locally, transmitted to another
30 location, or both. The images may be individual still photographs or sequences of images constituting videos or movies.

Step 3: At the second position, the Automated Load Transporter 100 needs to determine an alignment position (i.e. a third position) relative to the movable load 200 based on
35 machine vision algorithms by using input data obtained from the at least one sensor 104, such as video data from the camera. The at least one sensor 104 is configured for detecting a position of the moveable load 200 and a position of the Automated Load

Transporter 100. There are present at least two visual markers to facilitate detection of the position of the moveable load 200 and the position of the Automated Load Transporter 100. The at least one sensor 104 detects the positions of the moveable load 200 and the Automated Load Transporter 100 through detection of at least one such visual marker located on the Automated Load Transporter 100 and at least one such visual marker located on the movable load. The at least two visual markers may be a Quick Response (QR) code, a bar code, any other visible markings, and the like. Some visible markings may include embossed or engraved markings, coloured print, print having a specific shape, and the like.

Alternatively, instead of using the visual markers or additionally, the at least one sensor 104 may detect at least one feature of the Automated Load Transporter 100 and at least one feature of the movable load 200 to facilitate detection of the position of the moveable load 200 and the position of the Automated Load Transporter 100. The features that are present on the Automated Load Transporter 100 and movable load 200 includes but not limited to colour, edge, texture or shape on or of any part of the Automated Load Transporter 100 and the movable load 200 that are detectable by the at least one sensor 104.

When the at least one visual marker or features located on each of the Automated Load Transporter 100 and movable load 200 are at a fixed offset i.e. fixed distance with respect to each other or with respect to other visual marker or feature, which has been pre-determined, it would mean that the Automated Load Transporter 100 and movable load 200 are aligned correctly, and the alignment position (i.e. the third position) of the Automated Load Transporter 100 relative to the movable load 200 is determined. The processing unit 108 is used for processing position data of the Automated Load Transporter 100 and the moveable load 200 for determining alignment position (i.e. the third position) of the Automated Load Transporter 100 and the moveable load 200 in Step 4 as follows so as to enable the interlocking member 102 to couple with the receiving member 202.

It is appreciated that it is possible to use

- i) at least one visual marker located on the Automated Load Transporter 100 and/or at least one feature located on the Automated Load Transporter 100;
- and
- ii) at least one visual marker located on the moveable load 200 and/or at least one feature located on the moveable load 200,

to determine the positions of the Automated Load Transporter 100 and the moveable load 200 and/or to establish alignment between the Automated Load Transporter 100 and the moveable load 200.

5 Step 4: At the second position, a path to move the Automated Load Transporter 100 towards the movable load 200 will be calculated based on a kinematic model, which generally involves mathematics of motion without considering forces that affect the motion. The processing unit 108 is configured for determining the path to be taken by the Automated Load Transporter 100 to move to the alignment position (i.e. the third position)
10 of the Automated Load Transporter based on the position data of the Automated Load Transporter and the moveable load.

Step 5: When the path to move the Automated Load Transporter 100 to the third position has been calculated and determined, a motor driving, in this case, wheels of the
15 Automated Load Transporter 100 will be controlled to move the Automated Load Transporter 100 towards the movable load 200 based on the calculated path in Step 4. At the same time, the processing unit 108 may continuously obtain position data of the Automated Load Transporter and/or the movable load 200 from the at least one sensor 104 to provide feedback on updated current position of the Automated Load Transporter
20 100. The processing unit 108 may also continuously refine the calculated path in order to improve the alignment position (i.e. the third position) of the interlocking member 102 of the Automated Load Transporter 100 with the receiving member 202 of the movable load 200.

25 Step 6: When the Automated Load Transporter 100 has reached the alignment position (i.e. the third position) and the alignment position (i.e. the third position) between the Automated Load Transporter 100 and the movable load 200 is within a misalignment error tolerance, the actuator 106 located on the Automated Load Transporter 100 will be activated to move the interlocking member 102, in the present example, in an upwards
30 direction to couple with the opening 204 in the receiving member 202 from underneath the opening 204. The narrower part of the interlocking member 102 which is the top of the truncated pyramid 110 will first enter the larger part 206 of the opening 204 which is located at the bottom of the receiving member 202. The corresponding tapered shape of the opening 204 will guide the interlocking member 102 towards a smaller part of the
35 opening 204 which is visible and accessible from the top of the receiving member 202. It is appreciated that in another example, the interlocking member 102 may move in a downwards direction to couple with the opening 204 in the receiving member 202 where

the opening 204 has a corresponding tapered shape and cross-sectional area for receiving the tapered shape of the interlocking member 102. In this case, the opening 204 will have a larger part 206 at the top of the receiving member 202 and a smaller part at the bottom of the receiving member 202.

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In the present example, the interlocking member 102 has a first electrical contact, in this case, at least two electrical terminals serving as positive and negative terminals of an electrical circuit connected to a power source mounted at the Automated Load Transporter 100. When the interlocking member 102 and receiving member 202 are coupled, the first electrical contact of the interlocking member 102 will connect with a second electrical contact, in this case, at least two electrical terminals on the receiving member 202. The at least two electrical terminals on the receiving member 202 corresponds with the respective two electrical terminals of the first contact. Upon connection of the first electrical contact and the second electrical contact, the electrical circuit will be closed and power will be supplied from the Automated Load Transporter 100 to an electronic load on the movable load 200. Advantageously, this will power any electrical devices on the movable load 200 by using onboard power source of the Automated Load Transporter 100 without need to provide a separate power supply for the movable load 200.

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The actuator 106 can be configured to provide feedback to a control system operated by the processing unit 108 when the interlocking member 102 of the Automated Load Transporter 100 and receiving member 202 of the movable load 200 are coupled. In this case, the actuator 106 may have pressure sensors and/or electrical circuitries, and any other suitable means, connected up with the processing unit 108 to detect the coupling of the Automated Load Transporter 100 and receiving member 202. More details of the actuator 106 will be provided later.

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Step 7: This is the final step to verify that the interlocking member 102 is coupled i.e. successfully coupled to the receiving member 202. There are a few methods available for conducting the verification:

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(a) With reference to Fig. 1A, 1B and 2, to provide an electrical signal feedback when the interlocking member 102 is in contact with the receiving member 202 using the actuator 106, which can be configured to be aware of, for example, through pressure sensors and any other suitable means, when a lifter arm 112 is fully erected to couple the interlocking member 102 to the receiving member 202.

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The electrical signal feedback for detecting coupling of the interlocking member 102 and the receiving member 202 may also be obtained via closure of the electrical circuit upon connection of the first electrical contact on the interlocking member 102 and the second electrical contact on the receiving member 202.

5 (b) To use a machine vision method which detects using the at least one sensor 104 that the interlocking member 102 is fully coupled in the opening 204 of the receiving member 202.

10 (c) To move the Automated Load Transporter 100 forward or backward a short distance and using the machine vision method to detect using the at least one sensor 104 whether the distance moved by the Automated Load Transporter 100 relative to the movable load 200 is not a distance expected when the interlocking member 102 on the Automated Load Transporter 100 is decoupled from the receiving member 202 on the movable load 200.

15 (d) To move the Automated Load Transporter 100 forward or backward a short distance and detect presence of an additional load (i.e. the movable load 200) on the Automated Load Transporter 100 or additional current drawn by the motor to drive the wheels of the Automated Load Transporter 100 due to the additional load.

20 Below is also an example showing how the interlocking member 102 of the Automated Load Transporter 100 is being decoupled from a receiving member 202 of a movable load 200.

25 Step 1: The actuator 106 located on the Automated Load Transporter 100 is activated to move the interlocking member 102, in the present example, in a downwards direction to decouple from the opening 204 in the receiving member 202. The actuator 106 will provide feedback to the control system operated by the processing unit 108 when the interlocking member 102 of the Automated Load Transporter 100 and receiving member 202 of the movable load 200 are decoupled.

30 Step 2: This step is to verify that the interlocking member 102 has been successfully decoupled from the receiving member 202. There are a few methods available for conducting the verification:

35 (a) To provide an electrical signal feedback when the interlocking member 102 is not in contact with the receiving member 202. Similarly, the electrical signal feedback may be obtained from the actuator 106 configured to be aware of, for example, through pressure sensors and any other suitable means, when the lifter arm (112

in Figure 1B) is fully lowered to decouple the interlocking member 102 to the receiving member 202 and/or through the opening of the electrical circuit upon disconnection of the first electrical contact on the interlocking member 102 and the second electrical contact on the receiving member 202.

(b) To use the machine vision method which detects using the at least one sensor 104 that the interlocking member 102 is not in the opening 204 of the receiving member 202 i.e. fully decoupled.

(c) To move the Automated Load Transporter 100 forward or backward a short distance and using the machine vision method to detect using the at least one sensor 104 that the distance moved by the Automated Load Transporter 100 relative to the movable load 200 is not a distance expected when the interlocking member 102 on the Automated Load Transporter 100 is still coupled to the receiving member 202 on the movable load 200.

(d) To move the Automated Load Transporter 100 forward or backward a short distance and detect no presence of additional load (i.e. the movable load 200) on the Automated Load Transporter 100 or no additional current drawn by the motor driving the wheels of the Automated Load Transporter 100 due to no additional load.

More information on the actuator 106 as described with reference to earlier figures will now be provided. As shown in the figures containing the actuator 106 or as would be conceivable to a skilled person, the actuator 106 may include mechanical, pneumatic and/or hydraulic components including one or more of motor, gear, shaft, rod, lifting arm, cylinder, piston, pulley, hydraulic tank, and the like, for raising or lowering the interlocking member 102, or for raising the receiving member 202 in an example herein described or lowering the receiving member 202 in some other examples. Furthermore, movements of the actuator 106 may be controlled by the processing unit 108 or any other electrical device.

In another example, the interlocking member 102 and receiving member 202 may be configured such that more complex and active mechanisms are built onto the interlocking member 102 of the Automated Load Transporter 100 and simpler and passive mechanisms are built onto the receiving member of the movable load 200. This is because the artificial intelligence, processing and control are usually performed by the Automated Load Transporter 100 and not by the movable load 200. Another reason is that there is usually more movable load 200 than Automated Load Transporter 100 in an

Automated Load Transporter operation, hence it is more cost effective to make the receiving member 202 simpler.

In another example, it is preferred for the at least one sensor 104 such as at least one cameras that is installed on the Automated Load Transporter 100 to be facing downwards instead of facing upwards as dust will accumulate on the lens of the upward facing camera over a period of time. When the upward facing camera is placed under direct sunlight or ceiling light, the camera image will be over exposed. Under these conditions, the image quality and the machine vision algorithm performance will be affected. However, when the camera is facing downwards, the interlocking member 102 and receiving member 202 will both be visible to the camera.

In another example, the processing unit 108, actuator 106 and the at least one sensor 104 as shown in Fig. 1B may be removed from the Automated Load Transporter 100 and it is appreciated that the Automated Load Transporter 100 can be manually coupled to the movable load 200 by human or any other machine.

Furthermore, in another example, there may be present the actuator 106 as described in the Figures for moving the interlocking member 102 in a direction to couple with the opening 204 in the receiving member 202 and another similar actuator (not shown in the Figures) for moving the receiving member 202 in a direction to couple with the interlocking member 102. In yet another example, the two actuators may be the same actuator.

Whilst there has been described in the foregoing description embodiments of the present invention, it will be understood by those skilled in the technology concerned that many variations or modifications in details of design or construction may be made without departing from the scope of the present invention.

Claims

1. An apparatus for coupling an Automated Load Transporter to a moveable load, the apparatus comprising:

5 an interlocking member for coupling with an opening in a receiving member, the interlocking member having a tapered shape with a cross-sectional area having at least two edges, wherein the interlocking member is mounted on the Automated Load Transporter and the receiving member is mounted on the moveable load, or the interlocking member is mounted on the moveable load and the receiving member is
10 mounted on the Automated Load Transporter,

wherein the opening has a corresponding tapered shape and cross-sectional area for receiving the tapered shape of the interlocking member.

2. The apparatus as claimed in claim 1, the apparatus comprising:

15 an actuator for moving the interlocking member in a direction to couple with the opening in the receiving member.

3. The apparatus as claimed in claim 1 or 2, the apparatus comprising:

an actuator for moving the receiving member in a direction to couple with the
20 interlocking member.

4. The apparatus as claimed in claim 1, 2 or 3, the apparatus comprising:

at least one sensor configured for detecting a position of the moveable load and a position of the Automated Load Transporter;

25 a processing unit configured for processing position data of the Automated Load Transporter and the moveable load for determining alignment position of the Automated Load Transporter and the moveable load so as to enable the interlocking member to couple with the receiving member.

30 5. The apparatus as claimed in any one of the preceding claims, wherein the moveable load is a trolley or trailer, the trolley or trailer is configured to carry goods placed thereon.

6. The apparatus as claimed in any one of the preceding claims, wherein one of the
35 at least two edges is a sharp or rounded edge.

7. The apparatus as claimed in any one of the preceding claims, wherein the at least one sensor is used for detection of at least one feature of the Automated Load Transporter and at least one feature of the movable load to facilitate detection of the position of the moveable load and the position of the Automated Load Transporter.

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8. The apparatus as claimed in any one of the preceding claims, wherein the at least one sensor is used for detection of at least one visual marker located on the Automated Load Transporter and at least one visual marker located on the movable load to facilitate detection of the position of the moveable load and the position of the Automated Load Transporter.

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9. The apparatus as claimed in claim 8, wherein one of the at least one visual marker is a Quick Response (QR) code.

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10. The apparatus as claimed in any one of the preceding claims, wherein the processing unit is configured for determining a path to be taken by the Automated Load Transporter to move to the alignment position of the Automated Load Transporter based on the position data of the Automated Load Transporter and the moveable load.

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11. The apparatus as claimed in any one of the preceding claims, wherein the actuator moves the interlocking member in an upwards direction to couple with the receiving member from underneath the opening.

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12. The apparatus as claimed in any one of the preceding claims, wherein the cross-sectional area is rectangular or squarish with round edges.

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13. The apparatus as claimed in any one of the preceding claims, the interlocking member comprising a first electrical contact for connecting or disconnecting a second electrical contact on the receiving member to close or open an electrical circuit respectively when the interlocking member is coupled or decoupled to the receiving member respectively.

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14. The apparatus as claimed in any one of the preceding claims, wherein the processing unit is configured for verifying the interlocking member is coupled to the receiving member.

15. An Automated Load Transporter comprising the apparatus as claimed in any one of the preceding claims.

16. A method for coupling an Automated Load Transporter to a moveable load, the method comprising:

detecting a position of a moveable load and a position of an automated transportation device;

processing position data of the Automated Load Transporter and the moveable load for determining alignment position of the Automated Load Transporter and the moveable load so as to enable an interlocking member to couple with a receiving member, the interlocking member having a tapered shape with a cross-sectional area having at least two edges, wherein the interlocking member is mounted on the Automated Load Transporter and the receiving member is mounted on the moveable load, or the interlocking member is mounted on the moveable load and the receiving member is mounted on the Automated Load Transporter; and

moving the interlocking member in a direction to couple with an opening in the receiving member or moving the receiving member having the opening in a direction to couple with the interlocking member, wherein the opening has a corresponding tapered shape and cross-sectional area for receiving the tapered shape of the interlocking member.

17. The method as claimed in claim 16, the method comprising:

verifying the interlocking member is coupled to the receiving member.

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