Method and apparatus for automatically handling loads

A method for automatically handling loads substantially consists in performing operations for loading goods (60) into a vehicle body (50) and operations for unloading goods from a vehicle body by using automatically-controlled vehicles (2) provided with a location device (5) and with an onboard computer (3) which is interconnected to a main computer (4), which guide them in their programmed movements. The automatically-controlled vehicles directly enter the vehicle bodies to perform the goods loading and unloading operations, performing a three-dimensional virtual reconstruction of the interior of the vehicle body.
Description

[0001] The present invention relates to a method and an apparatus for automatically handling loads, particularly suitable for loading and unloading goods.

[0002] As is known, in view of the increasing burden of indirect costs linked to management activities, modern businesses put an increasing importance to logistics, i.e., to the set of activities for controlling the flows of materials starting from the output of the production lines to the end consumer.

[0003] One of those activities is the transfer of goods from loading and unloading areas to production equipment and vice versa; various systems are used such as trolleys, conveyor belts, robots and automatically-controlled vehicles.

[0004] Larger systems generally use automatically-controlled vehicles, i.e., lift trucks provided with an onboard computer, which calculates their position by using the information received from several transducers and checks their path constantly, being guided in their programmed movements by a main computer which implements route management applications software.

[0005] In order to further increase the efficiency of these line end automation systems, automatically-controlled vehicles have been set up, to also automatically perform the operations of loading and unloading the goods intended for shipping, with different approaches.

[0006] A first system, which is also the simplest, consists in placing the trailers or movable crates in preset loading areas and performing the loading and unloading operations from the ground, by interacting directly with the loading deck, which however must be accessible laterally.

[0007] Another system, conceived in order to utilize loading platforms and beds, consists in depositing the goods on movable platforms or on roller conveyors located proximate to the doors and in then pushing them into the vehicle bodies through the tailgate.

[0008] However, this solution does not allow to automate the unloading operations, and it has limitations also as regards loading operations, because they can be performed only on vehicle bodies provided with rollers or sliders which are integrated in the loading deck.

[0009] More recent systems are instead capable of guiding the automatically-controlled vehicles into the loading compartments, using the information provided by a set of specific sensors and/or references provided for this purpose on the vehicle bodies.

[0010] Although all the above systems ensure an increase in the efficiency of production management, they have a common drawback: it is impossible to perform loading and unloading operations by introducing the automatically-controlled vehicles also inside vehicle bodies or containers which are not provided with any special setup.

[0011] The aim of the present invention is to solve the problems described above by providing a method and an apparatus for automatically handling loads which allow to perform loading and unloading operations directly inside any type of vehicle body, even if it is not provided with specific setups.

[0012] Within the scope of this aim, a particular object of the invention is to provide a method and an apparatus which are flexible and optimize the management of the space in the vehicle body.

[0013] Another object of the invention is to provide a method and an apparatus which reduce the time required for handling and shipping goods.

[0014] This aim and these and other objects, which will become better apparent hereinafter, are achieved by a method for automatically handling loads, comprising operations for loading goods into a vehicle body and operations for unloading goods from a vehicle body, by using at least one automatically-controlled vehicle provided with a location device and with an onboard computer which is interconnected to a main computer, which guide it in its programmed movements, characterized in that said automatically-controlled vehicle enters directly said vehicle body to perform said goods loading operations and said goods unloading operations, said automatically-controlled vehicle performing a three-dimensional virtual reconstruction of the interior of said vehicle body.

[0015] This aim and these and other objects, which will become better apparent hereinafter, are also achieved by an apparatus for automatically handling loads, comprising at least one automatically-controlled vehicle, adapted to perform operations of loading goods onto a vehicle body and operations of unloading goods from a vehicle body, said automatically-controlled vehicle being provided with a location device and with an onboard computer which is interconnected with a main computer, which guide it in its programmed movements, characterized in that said automatically-controlled vehicle comprises an environment sensing means which performs a three-dimensional virtual reconstruction of the interior of said vehicle body.

[0016] Further characteristics and advantages of the invention will become better apparent from the following detailed description of a preferred but not exclusive embodiment of a method and of an apparatus for automatically handling loads according to the invention, illustrated by way of non-limiting example in the accompanying drawings, wherein:

Figure 1 is a schematic perspective view of an apparatus for automatically handling loads according to the invention;
Figure 2 is a perspective view of an automatically-controlled vehicle according to the invention;
Figure 3 is a side view of the automatically-controlled vehicle according to the invention;
Figure 4 is a perspective view showing a step of the method for automatically handling loads according to the invention;
Figure 5 is a perspective view showing another step
of the method for automatically handling loads according to the invention.

[0017] With reference to the cited figures, a method for automatically handling loads, according to the invention, substantially consists in performing operations for loading goods onto a vehicle body 50 and operations for unloading goods from the vehicle body 50 by using a plurality of automatically-controlled vehicles 2, each of which is provided with a location device with an onboard computer 3. The onboard computer 3 is interconnected with a main computer 4. The onboard computer 3 and the main computer 4 control the vehicle, in its programmed movements, within the production area or the storage area 50, in a per se known manner.

[0018] According to the invention, each automatically-controlled vehicle 2 directly enters any type of vehicle body 50, after performing a three-dimensional virtual reconstruction of its interior, which allows to autonomously identify empty spaces and any goods 60 which may be present in the vehicle body 50.

[0019] The operations of loading goods into the vehicle body 50 comprise a first step which consists in making the automatically-controlled vehicle 2 move toward the vehicle body 50, bringing it proximate to the access to the loading deck.

[0020] The location device is then temporarily deactivated and the automatically-controlled vehicle 2 performs a three-dimensional virtual reconstruction of the interior of the vehicle body 50 and recognizes the empty spaces within the interior of the vehicle body 50.

[0021] At this point, the automatically-controlled vehicle 2 is made to enter the vehicle body 50 and deposit the goods 60 in the empty spaces.

[0022] Finally, the automatically-controlled vehicle 2 is made to exit from the vehicle body 50 and the location device is reactivated and resumes guiding it in its programmed movements in cooperation with the onboard computer 3 and with the main computer 4.

[0023] The operations for unloading goods from the vehicle body 50 are performed in a similar manner and in the specific case include a first step which consists in making the automatically-controlled vehicle 2 approach the vehicle body 50, bringing it proximate to the access to the loading deck.

[0024] Then the location device is deactivated temporarily and the automatically-controlled vehicle 2 performs a three-dimensional virtual reconstruction of the interior of the vehicle body 50 and recognizes the goods 60 that have to be picked up.

[0025] The automatically-controlled vehicle 2 is then made to enter the vehicle body 50 and pick up the goods 60.

[0026] The automatically-controlled vehicle 2 is made to exit from the vehicle body 50 and the location device is reactivated and resumes guiding it in its programmed movements in cooperation with the onboard computer 3 and with the main computer 4.

[0027] According to the invention, an apparatus for automatically handling loads, generally designated by the reference numeral 1, performs the operations of loading goods onto a vehicle body 50 and the operations of unloading goods from the vehicle body 50 by using a plurality of automatically-controlled vehicles 2 provided with a location device and with an onboard computer 3 which is interconnected to a main computer 4, which guides them in their programmed movements.

[0028] Each automatically-controlled vehicle 2 is in fact provided with a location device comprising a laser scanner 5. The laser scanner 5 produces beams that are reflected by reflectors 6 which are applied in the production area or in the storage area 50. The location device detects such reflections and transmits their detections to the onboard computer 3. The onboard computer 3 calculates the position, using also the information received from other transducers, and constantly checks that the path and the position coincide with those programmed by the main computer 4.

[0029] According to the invention, each automatically-controlled vehicle 2 has an environment sensing means adapted to carry out a three-dimensional virtual reconstruction of the interior of the vehicle body 50, allowing to autonomously identify the empty spaces as well as any goods 60 which are already present inside the vehicle body.

[0030] The environment sensing means is constituted by a three-dimensional television camera 100, which is fitted to the automatically-controlled vehicle 2 and is inter-connected to the onboard computer 3, which physically performs the three-dimensional virtual reconstruction of the interior of the vehicle body 50 by utilizing image processing software.

[0031] The image processing software implements an algorithm which is based on parameter estimation methods and is capable of approximating the objects and the surfaces that are present inside the vehicle body 50 with geometric figures which are as simple as possible.

[0032] This refinement allows to perform the three-dimensional virtual reconstruction by autonomously identifying the empty spaces as well as any goods 60 that are already present inside the vehicle body 50.

[0033] A preferred parameter estimation method, which is particularly popular in the field of artificial vision and is sturdy, is commonly known as RANSAC and has been chosen for the processing of the images provided by the three-dimensional television camera 100.

[0034] The onboard computer 3 is also provided with a control for optimizing the loading plan. The control uses the information supplied by the environment sensing means and autonomously decides where and how to store the goods 60, managing the dimensional constraints of the loading units as regards any limitation in terms of weight, stackability, loading/unloading sequence.

[0035] In practice it has been found that the method and the apparatus for automatically handling loads ac-
cording to the invention fully achieve the intended aim and objects, allowing to perform loading and unloading operations directly inside the vehicle body, optimizing space management.

[0036] The method and the apparatus according to the invention are particularly flexible, since they can be used with all types of vehicle body and can also be used in existing line end automation systems, after providing the appropriate modifications.

[0037] In practice, the materials used, so long as they are compatible with the specific use, as well as the contingent shapes and dimensions, may be any according to requirements and to the state of the art.

[0038] This application claims the priority of Italian Patent Application No. VI2007A000143, filed on May 21, 2007, the subject matter of which is incorporated herein by reference.

Claims

1. A method for automatically handling loads, comprising operations for loading goods into a vehicle body and operations for unloading goods from a vehicle body, by using at least one automatically-controlled vehicle provided with a location device and with an onboard computer which is interconnected to a main computer, which guide it in its programmed movements, characterized in that said automatically-controlled vehicle enters directly said vehicle body to perform said goods loading operations and said goods unloading operations, said automatically-controlled vehicle performing a three-dimensional virtual reconstruction of the interior of said vehicle body.

2. The method according to claim 1, characterized in that said automatically-controlled vehicle autonomously recognizes the empty space inside said vehicle body.

3. The method according to claim 1, characterized in that said automatically-controlled vehicle autonomously recognizes said goods inside said vehicle body.

4. The method according to one or more of the preceding claims, characterized in that said operations for loading goods onto a vehicle body comprise the following steps:

- making said automatically-controlled vehicle approach said vehicle body;
- temporarily deactivating said location device;
- performing a three-dimensional virtual reconstruction of the interior of said vehicle body in order to recognize said goods;
- making said automatically-controlled vehicle enter said vehicle body;
- removing said goods from said vehicle body;
- making said automatically-controlled vehicle exit from said vehicle body;
- reactivating said location device.

5. The method according to one or more of the preceding claims, characterized in that said operations for unloading goods from a vehicle body comprise the following steps:

- making said automatically-controlled vehicle approach said vehicle body;
- temporarily deactivating said location device;
- performing a three-dimensional virtual reconstruction of the interior of said vehicle body in order to recognize said goods;
- making said automatically-controlled vehicle enter said vehicle body;
- removing said goods from said vehicle body;
- making said automatically-controlled vehicle exit from said vehicle body;
- reactivating said location device.

6. An apparatus for automatically handling loads, comprising at least one automatically-controlled vehicle, adapted to perform operations of loading goods onto a vehicle body and operations of unloading goods from a vehicle body, said automatically-controlled vehicle being provided with a location device and with an onboard computer which is interconnected with a main computer, which guide it in its programmed movements, characterized in that said automatically-controlled vehicle comprises an environment sensing means which performs a three-dimensional virtual reconstruction of the interior of said vehicle body.

7. The apparatus according to claim 6, characterized in that said environment sensing means comprises at least one three-dimensional television camera which is interconnected to said onboard computer.

8. The apparatus according to either claim 6 or 7, characterized in that said onboard computer comprises at least one control for optimizing the loading plan inside said vehicle body.
## DOCUMENTS CONSIDERED TO BE RELEVANT

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