Development of Lift Type Low-Platform Automatic Guided Vehicle (AGV) (3MS-3.5) and its Case Study

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Abstract

The 3MS-3.5 is our Automatic Guided Vehicle's (AGV's) first lift-up type low-platform (under a trolley) AGV. Since this AGV transports a cage trolley for workers, it is a useful mode of transporting goods in the logistics industry where the working population is lacking. Since our conventional U-CART model is a low-platform (below a trolley) towing type, it was necessary to process all the trolleys to be transported by U-Cart with towing coupling. The 3MS-3.5 eliminates the need to modify the trolley, whereby making it easier to install in various fields. Since the 3MS-3.5 has a small body width of 380 mm, the range of application of the cage trolley is expanded. Rather than lifting the trolley completely, the wheels on the lift-up slightly touch the ground. We realized both a compact body design and stability of the cage trolley during transportation.

1 Preface

Our Automatic Guided Vehicles (AGVs) were introduced in response to the automation of production lines in the automobile industry, and are currently automatically transporting various items throughout the manufacturing industry. Due to the expansion and increase of online shopping, manufacturing industry distribution centers in recent years are becoming larger and automatic transportation is required. In the logistics industry, people often use cage trolleys to carry transport goods within a facility, but due to the declining population of logistics workers and the minimizing of long-distance walking work, the demand for automatic transportation of cage trolleys is increasing. To meet this demand, we have developed a lift-type low-platform AGV that can be transported without modifying the cage trolley by going under the cage trolley and lifting it up directly. This paper introduces the features and specifications of the current lift-type low-platform AGV 3MS-3.5 developed.

2 Features

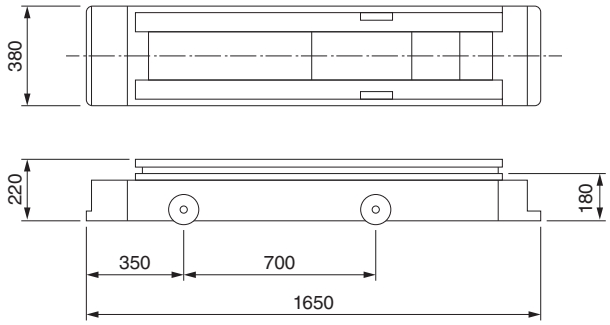
2.1 External Appearance of AGV and Payload

Fig. 1 shows the lift type low-platform (under trolley) AGV and Fig. 2 shows the outline drawing.

Fig. 1 Lift Type Low-Platform (under Trolley) AGV

The AGV goes under a cage trolley and directly lifts it up.

Since the vehicle height is as low as 180 mm, it can move under the cage trolley with ease. For this reason, cage trolleys can be put in a vertical direction without clearances and many cage trolleys can be accommodated in a narrow space. A vehicle width of 380 mm is in the smallest class in this business field. It is, therefore, possible to go under a cage trolley that has a narrow width. The maximum payload of a cage trolley is 350 kg. This type of AGV has a sufficient dynamic performance characteris-



Unit: mm

Fig. 2 Outline Drawing of Lift Type Low-Platform AGV

Since the vehicle body size is compact: W380 × H180 × L1650 mm, the AGV can go under the cage trolley.

tic to replace the former means of transfer by manpower.

2.2 Cage Trolley Sensor Unit

If cage trolley is incorrectly allocated, a trolley may fall down in the middle of lifting up or while traveling. The AGV is, therefore, equipped with a sensor that checks whether the AGV has accomplished a lift-up action correctly. The positioning of the cage trolley is supervised during the lift-up process and if the pallet posture is found faulty, the safety unit functions to generate an alarming signal and stops the AGV. Safety is enhanced further by examining the sensor error every time prior to taking a lift-up action.

2.3 Automatic Charging Function

By installing an automatic charging device on the ground side, the AGV can be automatically charged at specified locations and can operate continuously for 24 hours. Since the AGV control panel receives wireless instructions to charge the vehicle, priority is given to transport when the required amount of transport is large, and automatic charging is performed with appropriate timing such as when the demand is low. The remaining battery power can be monitored by the AGV itself, and when the remaining battery power level becomes low, it can be controlled to charge more than the usual level.

2.4 Wireless Local Area Network (LAN) Function

By mounting a wireless LAN unit on an AGV and wirelessly communicating with the AGV control panel on the ground, multiple AGVs can be operated efficiently. At intersections, AGVs pass through

Fig. 3 Lift-Type Low-Platform AGV Introduced at Electronic Component Assembly Line

Devices for autonomous guidance and laser guidance is installed.

wireless LAN units to avoid collisions. Cooperation with customer's facility is also automatically performed via wireless communication.

3 Case Study

3.1 Outline of AGV System

A lift-type low-platform AGV was introduced at the electronic component assembly line. Fig. 3 shows the external appearance. During the daytime, this AGV is responsible for collecting empty cage trolleys in response to calls from workers and collecting the trolleys at the collection point. At night, a large number of cage trolleys with parts are transported from the collection point to each assembly site. The number of transporting trolleys to each such place is made according to the transfer order by the control panel. As long as the battery level is sufficient, transportation is prioritized, and when the battery level is low, the AGV will automatically move to the charging location for charging.

3.2 Features

In this introduction, it is operated as a special design model (dedicated specification) that meets the requirements of the installation site. It operates

by switching between two methods: (1)“autonomous guidance”, which measures the surrounding environment with a laser range sensor and the AGV autonomously travels, and (2)“laser guidance”, which detects the position and orientation of the AGV with high accuracy by recognizing the reflector position by the AGV attached laser LiDAR while traveling. These two methods eliminate the need for magnetic tape on the floor, which is required for normal magnetic induction, and eliminates the vibration and shock applied to the parts on the cage trolley when rolling over the magnetic tape. A highly practical system has been constructed by adopting a method that allows AGVs to be called from a tablet terminal via wireless LAN. It is not necessary to lay fixed equipment such as call buttons and electrical wiring, which were required in the past.

4 Postscript

Labor shortages are becoming critical in various industries, and transportation automation by the AGV is rapidly in progress. Among the fast AGV-adopting markets, the logistics field is the key market where the transportation automation trend is particularly remarkable.

It has been difficult for conventional AGVs to meet the automation demands for cage trolley transportation. Going forward, by making the most of the lift-type low-platform AGV, we intend to meet the automation demands of customers.