

AGV System Supplied to a Large Construction Machinery Factory

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Abstract

Automated Guided Vehicles (AGVs) have been introduced to transport between processes on various production lines to reduce labor and workload. Recent production methods have changed from “small variety mass production” to “small-lot, multi-product production” and “mixed-model (variant-rich) production”, and AGVs are required to be operated in a way that is suitable for “small-lot, multi-product production”.

To achieve this, we have supplied an AGV system that can load heavy objects of various shapes to a construction machinery factory that produces small quantities of a wide variety of machinery products.

In order to build a system at minimum cost, we did not install a system control panel, and instead we offered a simple system of the AGV and an automatic charging device. The dispatching command to the AGV is also given by a remote controller (transmitter), eliminating the need for ground-side equipment. In addition, burying the AGV guidance wire (bar magnet) in the floor requires construction work, which increases costs, so instead, we adopted a method of attaching magnetic tape to the floor.

1 Preface

We supplied an Automated Guided Vehicle (AGV) system that transports six types of heavy parts for construction machinery from the shot blasting process (cleaning as a surface treatment for the parts) to the painting process. The AGV is a trolley-type AGV. This paper introduces the overview, features, and system configuration of the AGV system.

2 System Overview

This system consists of (1) one trolley-type AGV that can carry construction machinery parts with a maximum mass of 2000 kg, and (2) an automatic charging device. This system uses an automatic charging method, making battery replacement unnecessary. In order to prevent contact with nearby workers while the AGV is moving, a rotating beacon warning light is installed on the ground. When the AGV approaches a location where a warning is required, a radio signal is sent to the ground to turn on the rotating beacon warning light and alert the nearby workers.

3 System Features

The features of this system are as follows:

(1) Customization of AGV External Dimensions

To load six types of heavy parts for construction machinery, the width and length of the AGV were made approximately 700 and 1800 mm larger than the standard. If the width of the AGV exceeds the width of the transport truck (more than 2.5 m), a passage permit application is required, which increases the transport cost. Therefore, in consultation with the customer, we decided on an AGV width that does not require a passage permit application.

(2) Improved operability

(a) A switch box is installed on the AGV platform to improve the operability of the power/start switch and touch panel.

(b) By using an optical light remote controller, it is possible to give starting instructions without operating the switch or touch panel on the AGV body.

(3) Improved safety

(a) An emergency stop switch and signal tower are installed on the switch box on the AGV platform, making operation easier and improving visibility.

- (b) A rotating beacon warning light installed by the customer on the ground turns on when the AGV communicates with it, alerting nearby workers and preventing contact with the AGV.
- (c) Wiring is prepared inside the AGV machine base so that an automatic shutter and interlock can be installed.
- (d) If the AGV is loaded or unloaded during automatic charging, the AGV will shake, which may cause force to be applied to the charging actuator and damage it. Therefore, a start/stop switch for automatic charging is installed, and workers check that automatic charging is not in progress before transferring the transported items.

(4) Cost reduction of AGV system

- (a) The AGV control panel and wireless Local Area Network (LAN) are eliminated, resulting in a minimal system configuration.
- (b) Ground equipment is not required because the AGV dispatching command is given by an optical light remote controller.
- (c) A method is adopted in which the AGV guide wire is attached to the floor surface rather than buried in the floor.

(5) Operation

- (a) Transport is performed with priority over battery charging. Timely transport reduces waiting time in the later process.
- (b) The transport pattern changes depending on the day shift and the night shift, making it possible to switch between two transport patterns.

4 System Configuration

Fig. 1 shows the external appearance of the AGV. Fig. 2 shows the system configuration. Table 1 shows a list of specifications for the AGV and the transported items. The main system components are as follows.

- (1) AGV: 1 unit
Model: 3MC-M60 (special type)
Name: Omnidirectional traveling trolley type AGV
- (2) Automatic charging device: 1 set
- (3) Optical light remote controller for AGV start: 2 units (shared with optical light remote controller for manual operation)

5 System Operation

Fig. 3 shows the system layout. The system operation flow is as follows.

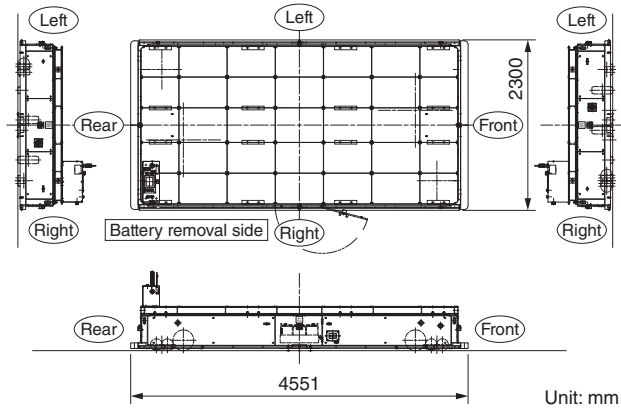


Fig. 1 External Appearance of AGV

The external appearance of the AGV is shown.

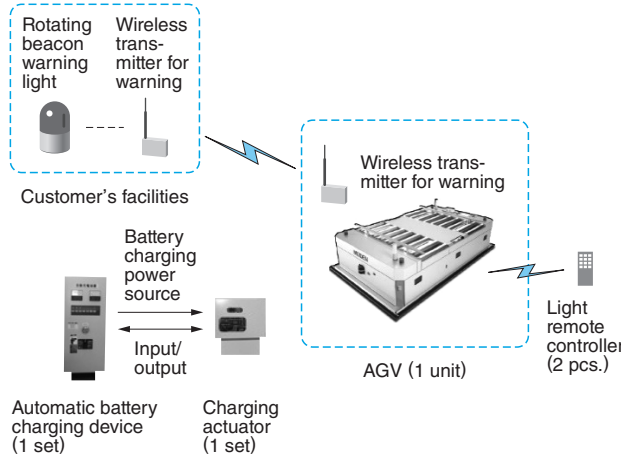


Fig. 2 System Configuration

The AGV system is composed of a single unit of AGV and one set of automatic battery charging device.

- (1) The worker sets the transport pattern on the touch panel of the AGV stopped at loading point (ST1).
- (2) The worker loads the item to be carried onto the AGV using a hoist crane.
- (3) After loading the item to be carried, the worker presses the start Switch (SW) on the optical light remote controller or the start SW on the AGV, and the AGV departs for unloading point (ST2).
- (4) The AGV automatically stops at ST3 just before ST2, and when the barrier opens, the operator presses the start SW on the optical light remote controller or the start switch on the AGV to start the AGV.
- (5) After arriving at ST2, the AGV unloads the carried item and the worker presses the start switch on the optical light remote controller or the start switch on the AGV, causing the AGV to return to ST1.

Table 1 List of Specifications

The AGV specifications applied to this system are shown.

Item		Specifications
Type		3MC-M60
Type		Trolley type
Quantity		1
Performance	Maximum payload (kg)	6000 kg
	Guide system	Magnetic
	Driving/steering system	Dual-drive diagonal-drive, steering system
	Traveling direction	Forward, backward, traversing, and diagonal
	Maximum traveling speed	Forward/backward: 30 m/min Traversing: 15 m/min
	Stopping accuracy	±10 mm
	Gradability	2% (5 m continuous)
Major dimensions	Body length	2740 mm (Delivered product: 4551 mm)
	Body width	1522 mm (Delivered product: 2300 mm)
	Body height	477 mm
	Chassis bed height	121 mm
	Minimum ground height	30 mm
	Battery	Type
	Voltage	48 V
	Charging system	Automatic battery charging system
Load transfer machine	System	Framework
	Load transfer height	FL + 598 mm
Transporting article	Product	Construction machinery components
	Dimensions	Max. W2180 × L4090 mm
	Mass	Max. 2000 kg
Safety equipment		Non-contact type obstacle sensor, tape switch, emergency stop switch, melody unit, stacked indicator light

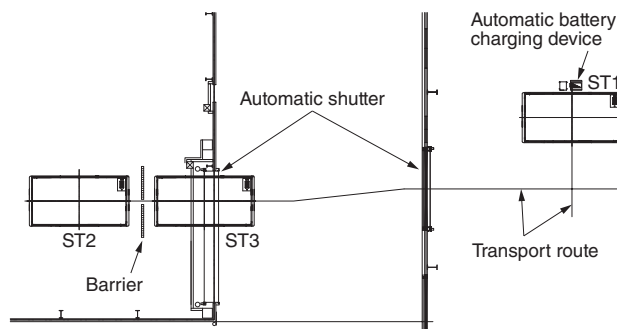


Fig. 3 System Layout

The AGV transport route is a single track system and it is a shuttle transport.

(6) The AGV returns to ST1 and automatically charges. If there is a next item to be carried, the AGV continues transporting without automatically charging.

6 Postscript

We introduced a case study of an AGV system supplied to a construction machinery factory. We have constructed a system that ensures safety and is easy to operate for workers, even with a minimal system configuration. In addition, by making the AGV machine dimensions larger than the standard specifications, it is now possible to load heavy construction machinery parts.

Going forward, we would like to continue to meet the needs of our customers and provide optimal AGV systems.

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