

AGV System for Paper Rolls

Kazuyoshi Itabashi

Keywords AGV, Paper rolls, Side fork, Laser-guided system, Replace

Abstract

The Automatic Guided Vehicle (AGV) is used as part of a production system in many industrial fields. Depending on the operational conditions of a facility and the use environment, customers tend to review overall production of their facility or consider replacement after the ten (10) to twenty (20) years. Compared with new construction, construction period for facility replacement takes about one extra week. Since a production line has to be stopped during a construction period, the customers always demand a minimized time of shutdown. We recently delivered a hybrid system which combines laser-guided AGVs to replace existing ones and a more automated transportation of products. The laser-guided system does not require an installation of guide paths. In addition, when this system is adopted, it becomes unnecessary to remove existing guide cables and install new guide paths. This means a substantial reduction of construction time. In the new system, AGVs in three different shapes travel in the factory area by using wireless LAN, whereby also giving standby control and destination instructions. This system is controlled centrally by the ground control panel and manage the system effectively.

1 Preface

In replacing an old type Automatic Guided Vehicle (AGV) system, it is necessary to remove the existing guiding facility and guide path wires. Compared with an introduction of a new AGV system, construction period for system replacement work takes about an extra week. For production lines running around-the-clock, the customers call for an introduction of a system requiring the shortest construction period because the system shutdown time must be minimized. To respond to such a demand, we have adopted a laser-guided system. When this system is used, it becomes unnecessary to consume time to remove electromagnetic guidepath wires buried in an existing facility. This paper introduces a new AGV system that has been introduced for a shorter installation period.

2 System Overview

We delivered two type AGVs: an AGV that can carry heavy articles of paper rolls and the other a side-fork type AGV for pallet and container trans-

portation. As a guide system, the laser-guided system is adopted. Each AGV is guided by a measuring distance to the reflector plate and by checking the map information. With this system, a paper roll weighing 3200kg (heavy article transport) or another paper roll weighing 2300kg (light article transport) can be carried. Each paper roll comes in a cylindrical shape. Since a paper roll is rolled from ground equipment when it is transferred to the AGV, the mechanical shock to the AGV is very strong and such an impact can lead to system malfunction. The AGV delivered for this time is equipped with outriggers that can absorb impact. This reduces failure risk after the introduction of the system.

3 Features of the System

(1) Adoption of common base vehicles against the replaced vehicles

The base vehicles come in two sizes; a large and a small AGV. Since the same type of AGVs is adopted, maintenance parts can be used. Since each the AGV is capable of omnidirectional traveling, it can run in a minimal space path. As a result,

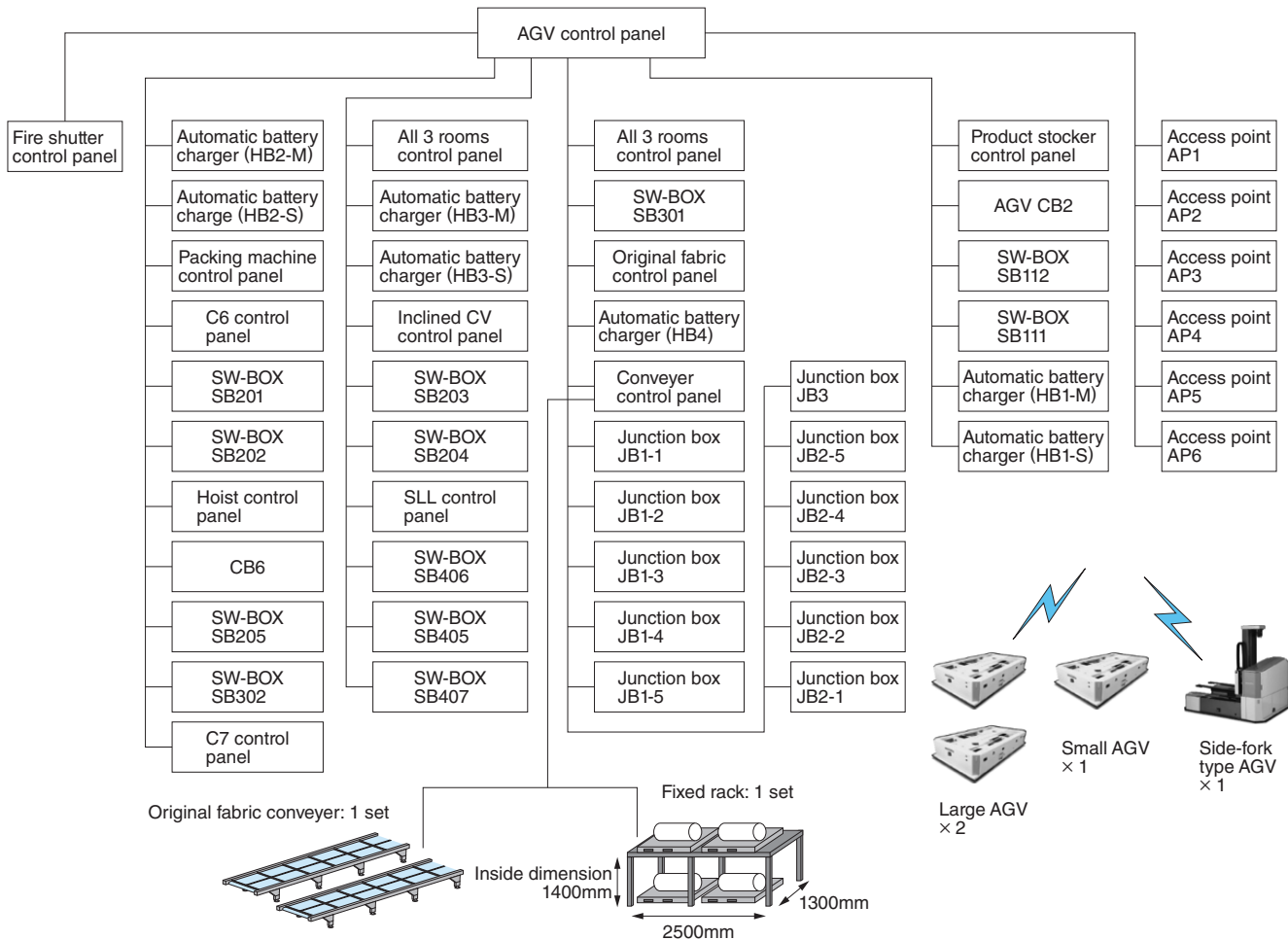


Fig. 1 System Configuration

The AGV system is composed of two AGVs for carrying large-sized paper rolls, one AGV for carrying small-sized paper rolls, and one side-fork type AGV.

the new type of AGV can travel to the areas where replaced AGVs cannot reach.

(2) Adoption of a side-fork AGV for new production facilities

A side-fork AGV has been adopted for carrying pallets and containers. In regard to the load transfer level, an article can be lifted to a maximum lift of 1600mm above the floor. It is, therefore, possible to lift a cargo to the upper stage of the two-stage rack. This AGV can run through a narrow path (width of path: 2400mm) and transfer the load there. Using this system, work with a manned forklift can be automated.

(3) Reducing construction period by adopting a laser-guided system

To reduce the construction period, a laser-guided system has been adopted throughout the guidepath. Work time for removal of existing guidepath wires by chipping is 3 days and installation of new guidepath wires takes 3 days. Such a timeline could be reduced

by this new system. Modification of layout and fine adjustments were carried out by using the CAD data. Since modification data can be downloaded to the AGV in this fashion, delicate route change can be instantly handled.

4 System Configuration

The supplied AGV system is composed of three (3) AGVs for paper roll transportation and one (1) side-fork type AGV for carrying a container on the exclusive rack. As an ancillary facility, a roller conveyer system is attached. This is for cargo reception and shipping. Fig. 1 shows a system configuration and Table 1 shows a list of specifications for the delivered AGVs and transporting articles.

4.1 AGV for Transporting Large-Sized Paper Rolls

Fig. 2 shows an external appearance of the

Table 1 List of Specifications

The list below shows three types of AGV specifications applied to this system.

Item	AGV for transporting large-sized paper rolls	AGV for transporting small-sized paper rolls	AGV for transporting container	
Type description	3MC-M30	3MC-M30	3ML-M11	
Type	Truck type AGV	Truck type AGV	Side-fork type AGV	
Quantity (units)	2	1	1	
Performance	Guidance system	Laser-guided system		
	Driving system	Front/rear wheel driving, steering system		
	Traveling direction	Forward, reverse, traverse, spin turn		
	Traveling speed (m/min)	10~40	10~60	10~60
	Gradability	2% (within 5m continuously)		
	Stopping accuracy (mm)	±10		
Major dimensions	Vehicle width (mm)	1522	1522	2278
	Vehicle length (mm)	3265	3800	1748
	Vehicle height (mm)	2525	2525	1738
	Minimum turning radius (mm)	1200	1200	1500
Storage batteries	Voltage/capacity	DC48V · 100Ah		
	Charging system	Automatic charging system		
Load transfer machine	System	Oil-hydraulic V-bucket system	Oil-hydraulic V-bucket system	Reach fork system
	Transfer direction	Right/left transfer	Right/left transfer	One-sided transfer
	Transfer height (mm)	FL + 840	FL + 640	FL~ 1600
Transfer article	Name	Paper roll	Paper roll	Container
	Size (mm)	L2250 × φ1500	L2250 × φ1400	W1500 × L1150
	Mass (kg)	Max. 3200	Max. 2300	Max. 1230
Safety device	Non-contact type of obstacle sensor, all-around tape switch, bumper, emergency stop switch, warning sound alarm, warning lamp			

AGV for transporting large-sized paper rolls. This AGV has been modified to assure a weight capacity of 3200kg and be available as omnidirectional transportation. The drive unit is composed of two-wheel differential driving mechanisms. In order to suppress the vehicle height, the steering motor has been eliminated. The V-bucket for loading a paper

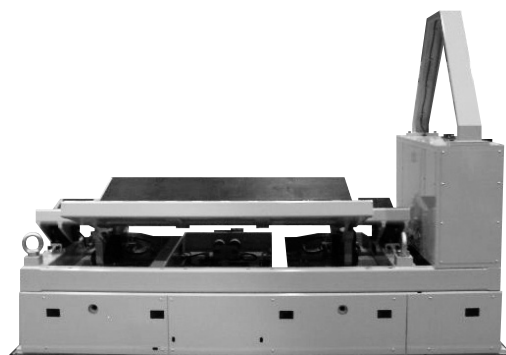


Fig. 2 AGV for Transporting Large-Sized Paper Rolls

An external appearance of an AGV for transporting large-sized paper rolls is shown. It is equipped with a V-bucket load transfer machine.



Fig. 3 AGV for Transporting Small-Sized Paper Rolls

An external appearance of an AGV for transporting small-sized paper rolls is shown. It is equipped with a V-bucket load transfer machine.

roll is controlled oil-hydraulically and mechanical impact to be generated at the time of paper roll loading is absorbed by using outriggers.

4.2 AGV for Transporting Small-Sized Paper Rolls

Fig. 3 shows an external appearance of the AGV for transporting small-sized paper rolls. The basic structure of this AGV is the same as that of the AGV for large paper roll transportation. Compared with the large paper roll type, the paper roll transfer height is lowered by 200mm. The component allocation layout inside the AGV was reviewed and by patting the shaft section of the V-bucket component inside the AGV it realized a reduction of transfer height.

4.3 AGV with Side Fork

Fig. 4 shows an external appearance of the AGV for a transporting container. This model was

made by modifying the AGV introduced on order page (see p.14) in this paper under the title of “Development of Side-Fork Type AGV.” The transfer mass is 1230kg (rated transfer mass: 1100kg) and this value exceeds the rated level. As such, the



Fig. 4 AGV for Transporting Container

An external appearance of a side-fork type AGV for transporting a small-sized container is shown.

structures of the traveling and lifter sections were reviewed and the speed reducer of the lifter was modified.

5 System Operation

Fig. 5 shows the system layout.

(1) Each AGV is called up from the operator box located in each process. The system control panel grasps the call-up situation in order to dispatch a right fit.

(2) There are three operation modes available as described below.

(a) Mode in which a dedicated AGV is operated in the transport area.

(b) Mode in which multiple AGVs are used for transportation in a specific process.

(c) Mode in which transportation is carried out considering the order priority.

The user can manage the system by making a switchover to an adequate mode by confirming the manufacturing status. By the modal change capability, the production yield can be increased by 20%

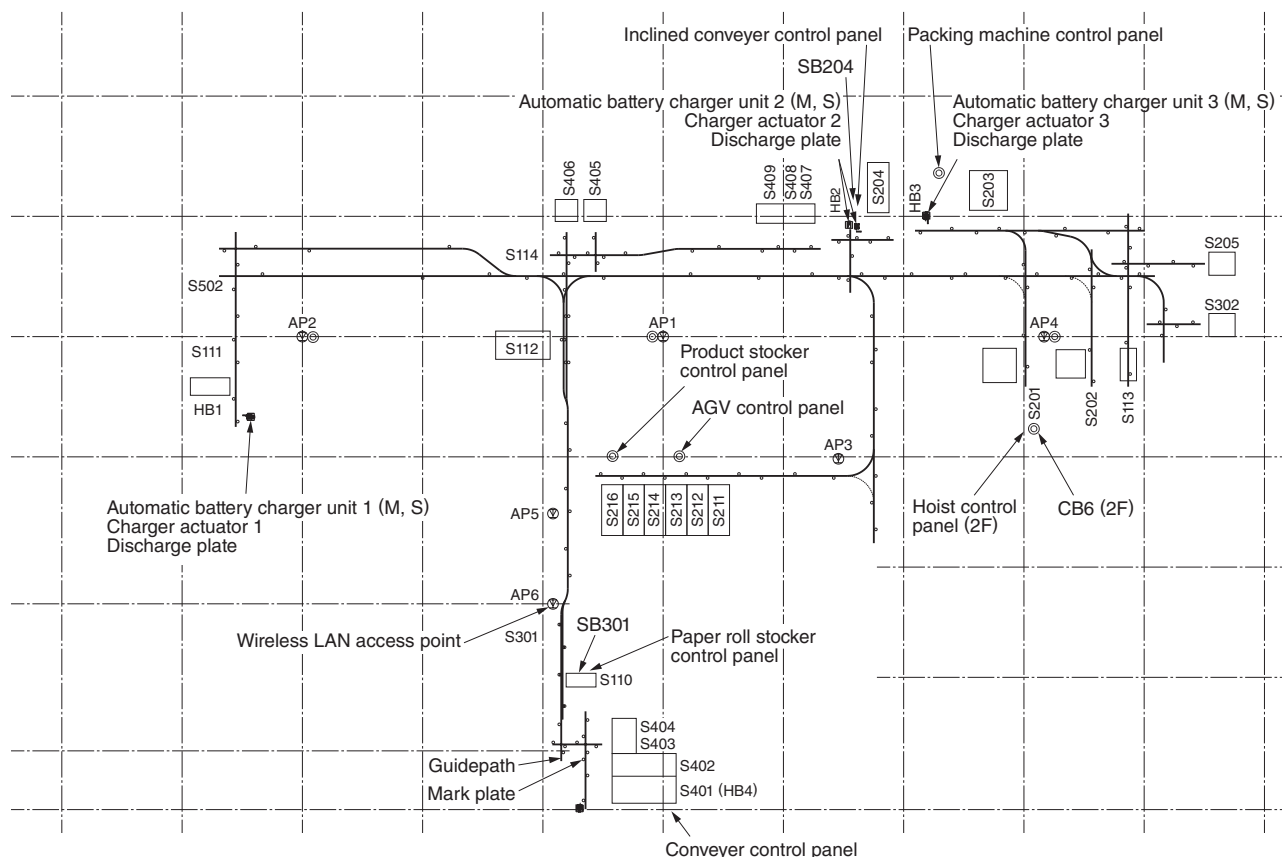


Fig. 5 System Layout

The layout of the AGV system (4 AGV units in all) is shown. Since the AGV routes cross each other, crossing point control and standby control are carried out by using wireless LAN.

compared with conventional volumes because it can flexibly handle the production peak time.

(3) All AGVs are centrally controlled by using wireless LAN. It is, therefore, possible to grasp the real-time AGV running conditions. Any error information can be announced without delay. As an error reset operation is shown in the screen of the system control panel, it can be done without referring to an instruction manual.

6 Postscript

The AGV system introduced in this paper adopted is intended as a laser-guided system to perform the replacement work of an existing facility. This is because replacement work must be finished

in the shortest possible time. Since the major components are the same ones used in the different types of AGVs, it can contribute to maintenance cost reduction for the customer.

Meeting the requests of our customers: from introduction planning to maintenance, we customized the AGV system and the AGV itself. To be a leading supplier of transport systems, we would like to provide system solutions that realize the added values of low cost and high performance AGV system with added functions. In so doing, our work will not be limited to the simple replacing work of the aged AGV facilities.

· All product and company names mentioned in this paper are the trademarks and/or service marks of their respective owners.