

Automated Guided Vehicle (AGV) System for Transporting Workpieces into Furnace

Keywords Firing furnace, Accuracy, Stop position correction, Turntable, Guiderail

Abstract

Automated Guided Vehicles (AGVs) have been introduced to transport workpieces in various production processes to reduce labor and workload, and have the advantage of being able to set the workpieces in the exact same position.

We recently supplied an AGV system by which the workpieces can be placed in an accurate position in a narrow space of the firing furnace where the clearance between furnace wall and workpiece is very narrow in order to increase the thermal efficiency.

Previously, workers used a manual lifter to carefully insert and remove the workpieces, taking time to check the position. This time, a workpiece loading section is attached to the AGV, and the workpiece loading section is moved according to the guide on the ground side. This made it possible to insert and remove the workpieces in the furnace accurately without touching the furnace wall. This mechanism achieved accurate positioning while reducing the number of workers required for inserting and removing the workpieces.

1 Preface

We supplied an Automated Guided Vehicle (AGV) system that transports the workpiece (pre-baked product) to the firing furnace and automatically inserts and removes it. The AGV used is a fork-type AGV (2APLB-8). This paper introduces the AGV system that realizes insertion and removal of the workpiece inside the furnace.

2 System Overview

The clearance between the furnace wall and the workpiece is very narrow to improve thermal efficiency, and there was a risk that the workpiece would come into contact with the furnace wall when inserted or removed depending on the precision level of the AGV.

Therefore, a guide rail was installed at the bottom of the furnace, and a turntable on which the workpiece is placed was installed on the fork of the AGV. The guide roller on the AGV corrects the position and angle within the guide rail.

The guide roller and the turntable are connected by two wires and are mechanically synchronized. Compared to a method of synchronization

using a servo motor, this contributes to reducing the number of parts and the failure rate.

Contact between the workpiece and the furnace wall must be avoided as it can damage the furnace. For this reason, two types of safety devices are installed. One uses a laser beam to measure the distance between the turntable and the furnace wall, and stops the AGV if it comes closer to the furnace wall than a preset value. The other is equipped with a contact sensor as a backup for laser beam detection, and stops the AGV if the sensor arm comes into contact with the furnace wall.

These safety devices have realized an AGV with a transfer function that prevents contact while maintaining the clearance between the workpiece and the furnace wall. [Fig. 1](#) shows the external view of the AGV.

When a worker places a workpiece on the pick-up and drop-off point stand station (hereinafter referred to as “stand station”), any deviation can cause contact with the furnace wall regardless of the AGV mechanism. A laser light sensor detects the workpiece position to ensure that it is placed in the correct position, preventing the workpiece from being misaligned or placed at an angle.

Previously, inserting and removing a work-

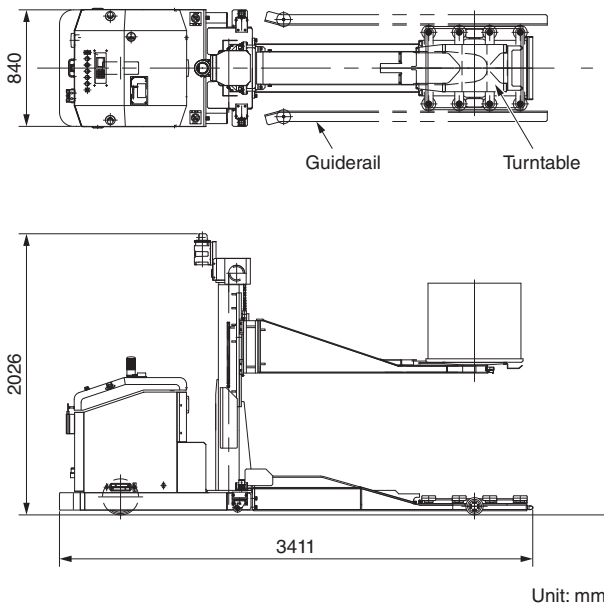


Fig. 1 External View of AGV

An external view of AGV is shown.

piece into and from a firing furnace required time-consuming insertion and removal while repeatedly checking the clearance between the pre-baked product and the furnace wall using a manual lifter. The introduction of the AGV has made it possible to automatically insert and remove the workpiece accurately in a short time.

Although the frequency of insertion and removal work is not high because the firing time is long, automating the insertion and removal of the workpieces from the five firing furnaces has contributed to labor savings.

3 System Configuration

The AGV is a special type with a turntable instead of the standard fork, and is laser guided, with AGV dispatching control performed by the system control panel. The main system configuration equipment is as follows:

- (1) 2APLB-8 special type: 1 unit
- (2) System control panel: 1 panel
- (3) Automatic charging device: 1 set
- (4) Wireless LAN access point: 2 sets
- (5) Interlock panel: 1 panel (customer's equipment)
- (6) Furnace control panel: 5 panels (customer's equipment)

The system configuration is shown in **Fig. 2**.

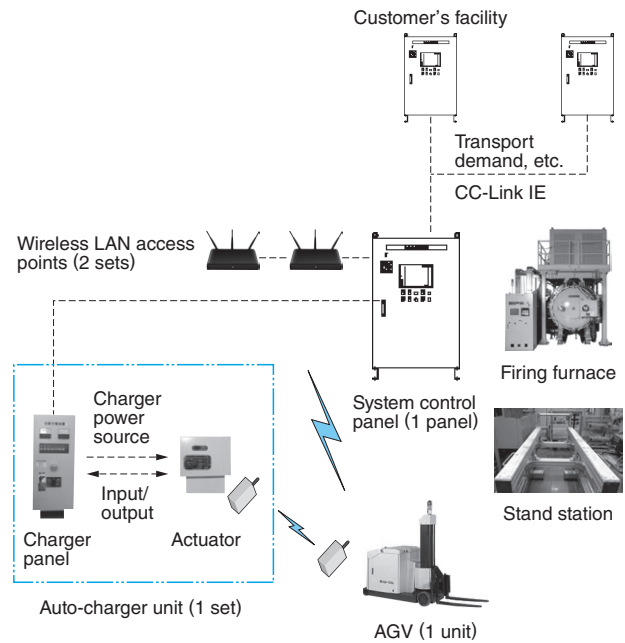


Fig. 2 System Configuration

The relationship among devices is shown in system configuration.

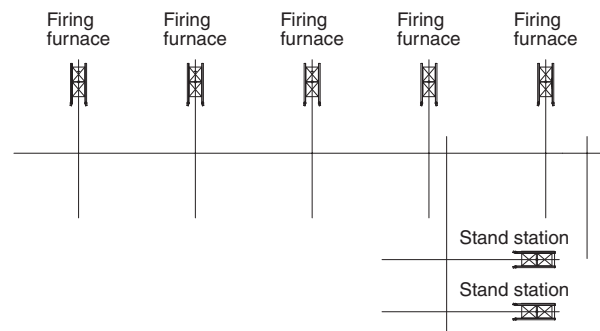


Fig. 3 Layout of Equipment

The facility layout is shown.

4 System Operation

The layout of the equipment is shown in **Fig. 3**.

- (1) The worker sets the workpiece at the stand station.
- (2) The door of the furnace to be inserted into is opened, and an instruction to transport the workpiece from the stand station to the furnace is issued.
- (3) The AGV places the front workpiece, which is divided into two parts at the stand station, on the turntable, automatically transports it to the furnace, and inserts it into the back of the furnace.
- (4) The AGV returns to the stand station, transports the workpiece on the back side of the stand station, and inserts it into the front of the furnace.

(5) Conversely, when transporting from the furnace to the stand station, the workpiece on the front side of the furnace is placed at the back of the stand station, and the workpiece on the back side of the furnace is transported to the front of the stand station.

The effects of introducing this system are as follows:

- (1) Labor saving
- (2) Accurately maintains the clearance between the furnace wall and the workpiece
- (3) Reduces the risk of damage to the furnace wall
- (4) Smartly visualizes maintenance schedules based on transport and anomaly logs

5 Postscript

We introduced a system that can automatically and accurately perform insertion and removal work of workpieces inside a narrow furnace by using an AGV instead of a manual lifter. The introduction of the AGV system has significantly improved the customer's work efficiency and contributed to labor saving.

Going forward, we would like to continue to meet our customers' needs and provide the optimal transport system.

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