Automated Guided Vehicle (AGV) System for Transport Between Polishing Equipment Point and Clean Equipment Point

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Abstract

We supplied an Automated Guided Vehicle (AGV) equipped with a collaborative robot to a semiconductor manufacturer. We have RocoMo-V model – an AGV equipped with a collaborative robot. There was a request to install a water tank on the loading platform. Since the payload capacity was insufficient, we equipped a trolley-type AGV (3MC-M10) with a collaborative robot CRX-20iA/L (Payload 20 kg) made by FANUC CORPORATION.

To handle semiconductors, a water tank is onboard and the workpieces are transported without being exposed to the air, and the water in the tank is automatically replaced after a certain period of time.

The system control panel is equipped with a communication software that complies with the Semiconductor Equipment and Materials International (SEMI) Standard, and communicates with the upper system and ground facilities.

1 Preface

Conventionally, the Overhead Hoist Transport (OHT) type Automated Guided Vehicle (AGV) has often been used for transport between processes in semiconductor manufacturing plants. OHTs require the installation of rails, and large-scale construction is required when changing the layout. By equipping a laser-guided AGV with a collaborative robot, we have achieved the transportation of semiconductor wafer transport boxes without the use of an OHT. Laser guidance makes it easy to change the travel path, and the use of a collaborative robot eliminates the need for safety fences, which are necessary for industrial robots. This paper introduces an AGV system that realizes the transportation of semiconductor wafer transport boxes.

2 System Overview

This system transports a transport box containing silicon wafers from a polishing equipment point to a cleaning equipment point in an ISO 14644-1 Class 6 clean environment. The AGV equipped with a water tank automatically moves to a water exchanger after a certain period of time and replaces the water in the tank. By submerging the transport box in the tank, it can be transported without being exposed to the air. The water in the tank is ultrapure water, and the tank and the robot hands are made of non-metallic parts to prevent metal contamination of the water that could affect the silicon wafers.

Communication with the Manufacturing Execution System (MES) is compliant with SEMI-E5 and E37, and transfer with ground equipment is performed using an interlock compliant with SEMI-E84. Fig. 1 shows the external view of the AGV equipped with a collaborative robot.

3 System Configuration

Fig. 2 shows the system configuration. The main equipment and devices are as follows:

(1) AGV: 3MC-M10
(2) System control panel
(3) Wireless LAN access point
(4) Automatic charging unit (parallel operation)
(5) Reflector
(6) Polishing equipment (customer's equipment)
(7) Cleaning equipment (customer's equipment)
(8) Water exchange equipment (customer's equipment)

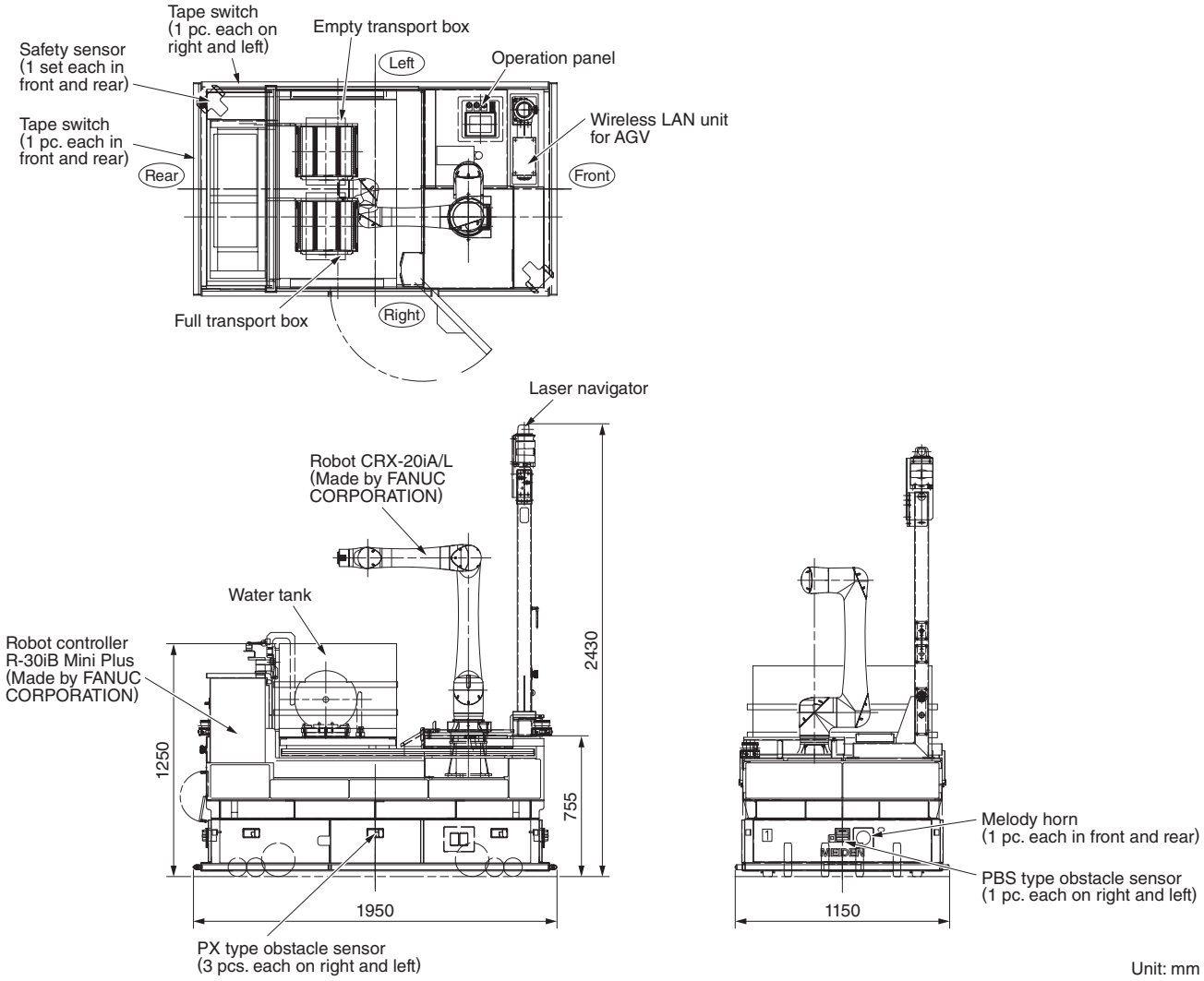

Fig. 1 **External View of AGV Equipped with Collaborative Robot**

External view of the AGV is shown.

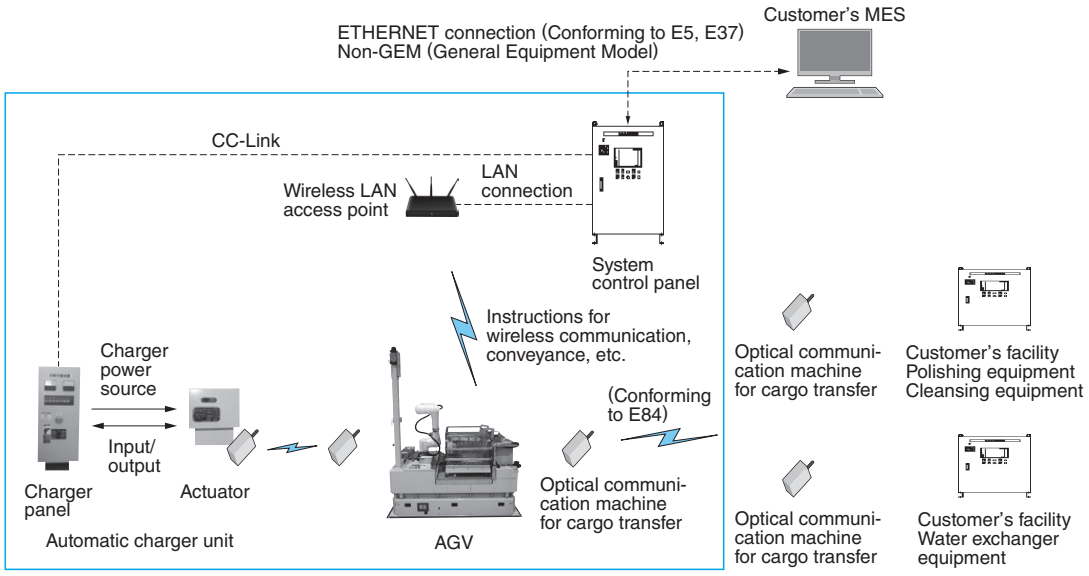

Fig. 2 **System Configuration**

Configuration of the AGV system is shown.

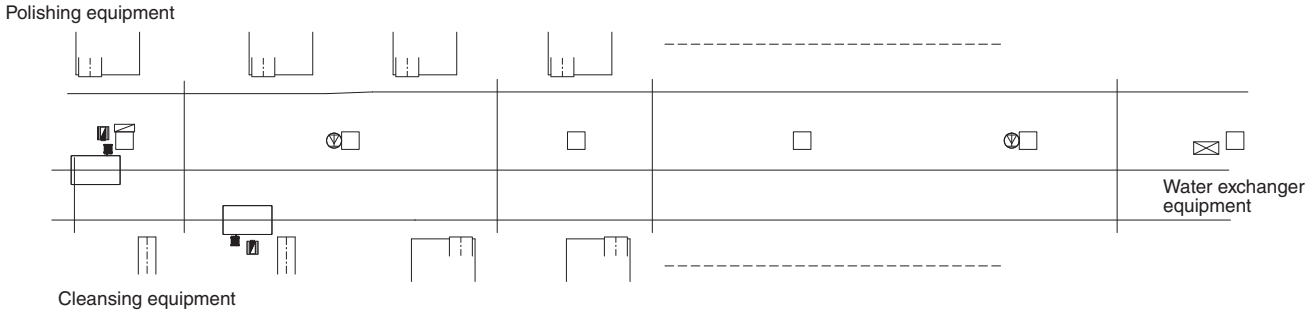

Fig. 3 System Layout

The cargo transfer system layout is shown.

(9) MES (customer's equipment)

4 System Operation

Fig. 3 shows the system layout.

(1) Normal transport

(a) The AGV at the automatic charging Station (ST) waits for a transport request to be output from the MES with an empty transport box in the water tank.

(b) When a transport request is output from the customer's equipment, it heads to the designated polishing equipment.

(c) When it arrives at the polishing equipment point, it takes a transfer interlock with the polishing equipment using the optical communication unit and loads the actual transport box. After completion, it takes an interlock again using the optical communication unit, unloads the empty transport box, and heads to the designated cleaning equipment.

(d) When it arrives at the cleaning unit, it takes a transfer interlock with the cleaning equipment using the optical communication unit and unloads the actual transport box. After completion, it takes an interlock again using the optical communication unit and loads the empty transport box. After transfer is complete, it heads to the automatic charging ST.

(e) After arriving at the automatic charging ST, the charging time has elapsed, and the next transport request is confirmed.

After that, the above steps (a) to (e) are repeated.

(2) Water exchange: The system control panel manages the water exchange time for each AGV car, and when the water exchange time has elapsed, the system control panel instructs the AGV to transport the AGV to the water exchange equipment without going through the upper system.

(3) Detour transport: By setting the ST of the polishing unit being maintained on the touch panel mounted on the system control panel, the AGV will detour around the ST.

5 Postscript

We introduced a case where AGVs with a collaborative robot and a water tank are used to transfer items between processes in a semiconductor manufacturing factory.

The flexible collaborative robot, which moves with high precision, can carry out transfers that were difficult with conventional AGVs, and the control of the collaborative robot and the AGV is achieved by applying the know-hows we learned through the supply of RocoMo-V series – an AGV with a collaborative robot.

In addition, the software we created this time also achieved communication in accordance with the SEMI Standard, which is the semiconductor industry standard.

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