STUDY ON THE IMPLEMENTATION OF WIRELESS CHARGING SOLUTIONS FOR AGVS

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In the industry but also for the area of logistics warehouses, the transit is made with vehicles with automatic guidance (AGV), which are used very often, they have evolved and are much more and the most important are the vehicles with wireless charging because energy transfer is much more efficient than electrical circuits, outlets and cables that degrade over time. Self-propelled vehicles that can be loaded during operation are a continuous flow to increase productivity and improve flexibility in the logistics warehouse or production flow.

1. Introduction

In order to implement a solution with automatic-guided vehicle-type transfer (AGV) equipment to be loaded wirelessly on the logistics flow within a warehouse, it is necessary to meet the following objectives:

- the use of 98% automated technology to allow wireless charging of transport-transfer equipment during working hours;
- the use of transport-transfer equipment which can be adapted to the level of demand in a number covering the entire flow; the use of a soft building systems management (BMS) for operators so that the flow is monitored 24 hours, 7 days a week;
- maintenance costs in the first 3 years must be a maximum of 5% .

2. The current stage

Automation in the production area or in logistics centers and storage areas involves the use of modern technology to increase productivity. Automation can be digital and refers for example to the automation of the inventory data collection process or it can be a more complex physical automation, involving mechanized and automated equipment and solutions [1].

Thus, in addition to using a warehouse management system that allows you to check where the goods are stored and what areas are available for storage of various items, the implementation of a flow that uses conveyors for transporting products or an automatic storage and recovery system will eliminate routes long and mixed cargo areas [2].

Physical automation of warehouses requires the use of automated equipment to eliminate manual movements and streamline logistics processes, this includes the use of automatic guided vehicles (AGV), automated palletizing systems, automated wrapping systems, robotic lifting systems, etc.

AGVs handle products in transport-transfer processes, which are connected to one or more loading and unloading points. When several AGVs are used (figure 1), they are connected to the network through an internal server that allows real-time management and monitoring of their activity. Route planning can also be changed in real time and the approval of sections on the route or intersections is done through GPS devices that communicate with each other. A very

complex system also needs a BMS that also monitors the loading of individual devices to maintain optimal availability [3].

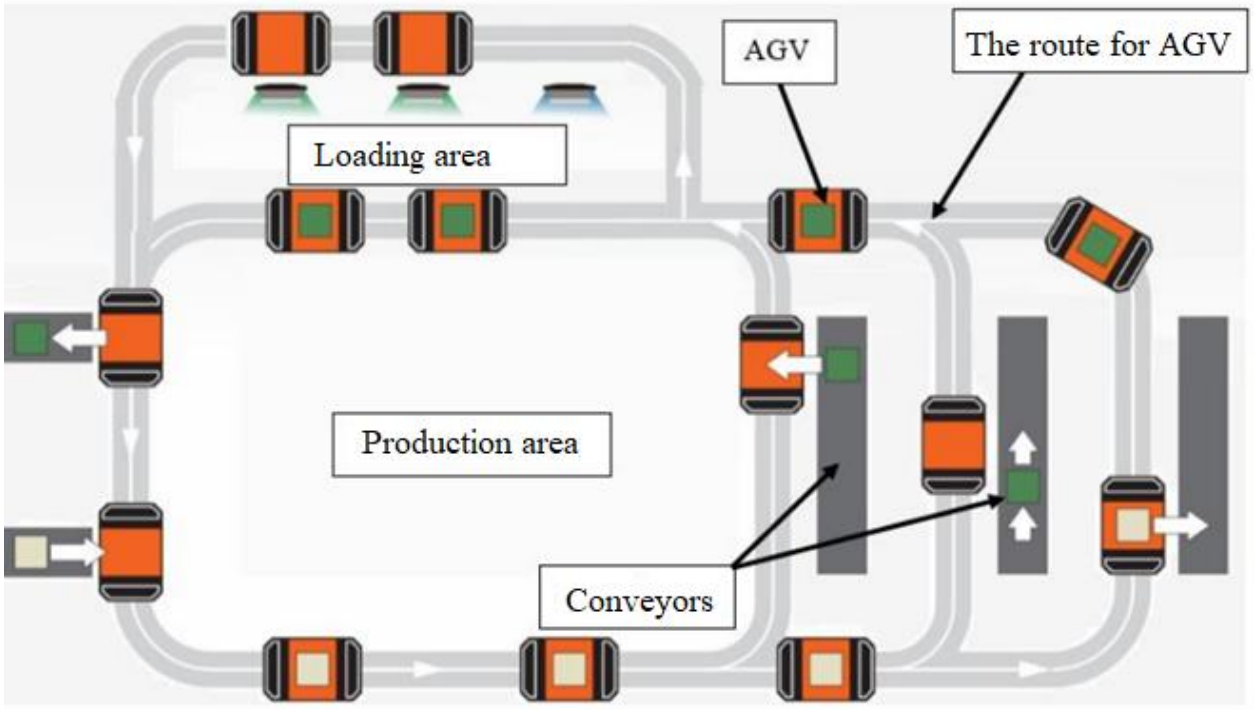

Fig. 1. Logistics flow for a production area with several AGVs

Automatic loading of self-guided vehicle transport-transfer equipment is very beneficial as it allows this equipment to work continuously without the need to park for long periods during loading. Also, the implementation of such a solution allows the required number of transport-transfer equipment to be smaller compared to the case where the classic load is used.

Wireless charging for AGV is the technology of the future when it comes to electric vehicles. In addition to the development of intelligent algorithms, sophisticated sensor technology and decentralized intelligence, which give AGVs intelligent behavior, the solution for inductive charging (wireless charging) transforms AGVs into fully autonomous equipment that can work independently of human operators. can be monitored remotely.

The charging system thus allows to increase the degree of automation of transport-transfer and storage operations without wasting additional time for charging the batteries [4].

Wireless or inductive charging is suitable for all types of batteries listed below:

- Acid-based lead batteries ;
- GEL / AGM batteries ;
- Pure lead batteries ;
- Lithium batteries.

2. Constructive solutions and implementation of wireless charging technologies for AGVs

Wireless charging of AGVs allows their functionality 24/7, this being a modern solution of "charging in the transit process without operator" that allows vehicles to be powered efficiently and completely automatically without operator intervention and without the need for AGV to interrupt the transport for very long loading breaks.

Wireless charging for automatically guided vehicles can be implemented both for AGVs used in industries and for those used in distribution centers or in any other type of activity that involves the handling of goods. The intermediate energy transfer allows the batteries in the AGVs the intermediate charge in order to keep the energy level of the transport-transfer systems at a constant level if it is a busier day in the flow.

The wireless charging process is as follows: when the AGV is positioned next to the charging station (figure 2) the control panel sends a signal to the active coil where an electromagnetic field is created that resonates with the charging unit where another coil is located and then the battery starts charging [5].

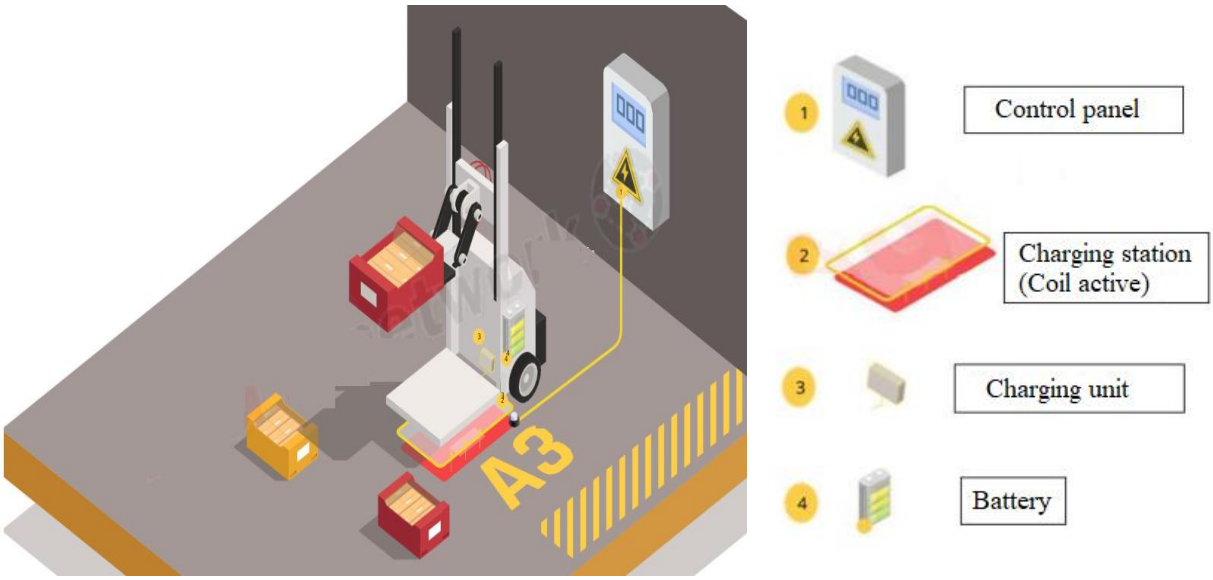

Fig. 2. Wireless charging station

Modernization in the logistics area means automation with wireless charging technologies, which do not require interventions in the infrastructure of the entire warehouse but only on a certain frequently traveled route or at the charging stations that can be placed on the walls or floor. Inductive coil charging systems are much easier to make mechanically because they do not require mechanical contacts, and their maintenance is much easier to achieve and is suitable for long-term continuous use.

The battery and the charging system (figure 3) together form a general solution for power supply and are connected via a CAN interface [6].

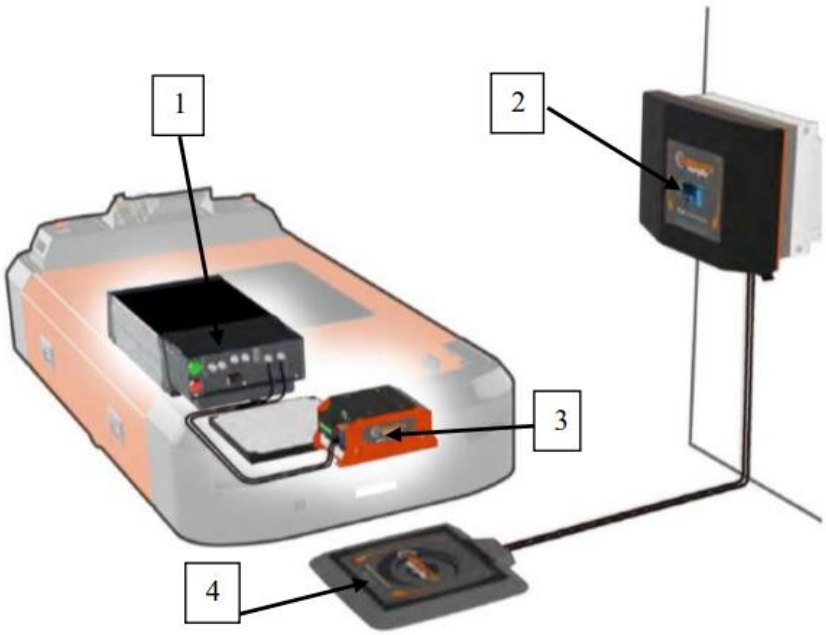

Fig. 3. The basic components of the AGV system and the charging station

The elements presented in figure 3 are: 1 - battery , 2 - HMI / IPS control unit (Inductive Power Supply), 3 - MPU controller (Mobile Power Unit) and 4 - ISP charging station (Inductive Stationary Pad).

The optimal location and distance between the two coils are shown in Fig. 4 where the two pads are highlighted: an inductive mobile pad mounted on the AGV and a stationary pad mounted on the charging station. The power supply converts the power of electricity to a frequency of several thousand hertz and uses the coil in the stationary charging plate to create an alternating field. This field, whose resistance is similar to that of a conventional induction resistor, induces a high frequency alternating current in the coil of the receiver board. The charger then uses this current to charge the batteries.

Fig. 4. Location and distance of the two coils

In the connection structure of the general elements, shown in figure 5, there is as a control unit an HMI interface (IPS) through which the main settings regarding the charging power in the range of 15-80 kw / h and the charging station can be made (ISP) where the active coil creates the electromagnetic field that is transmitted to the charger (IMP) positioned on the structure of the AGV . Within the wireless charging system there is a controller that has the role

of converting the energy required to charge the batteries of the AGV to specific parameters. (MPU) [7].

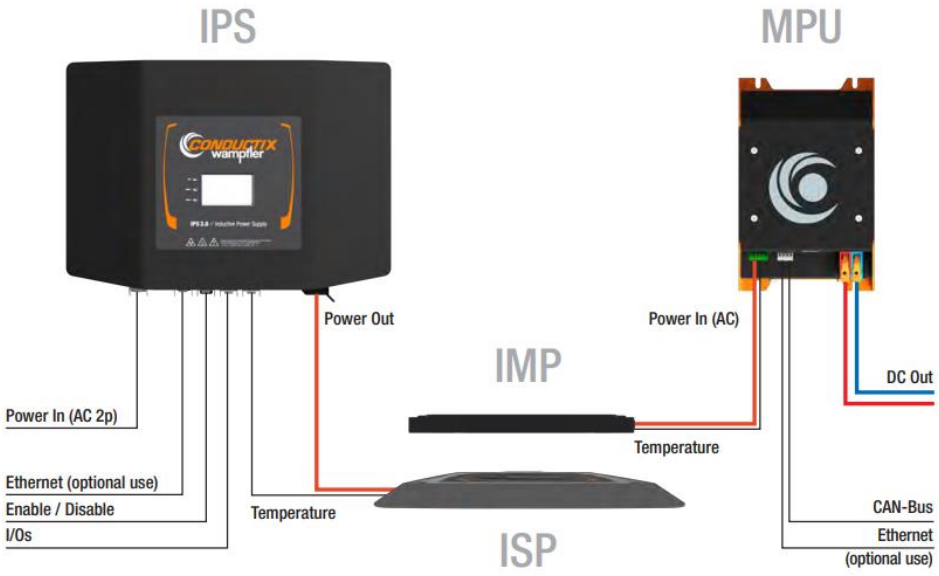

Fig. 5. Connection structure of the general elements

In fig.6. the PLC is connected to the AGV control system (CPU) for real-time monitoring of route changes, various work processes or if there are technical problems related to the operation of the AGV especially in the battery area, even if the batteries are provided with additional protection.

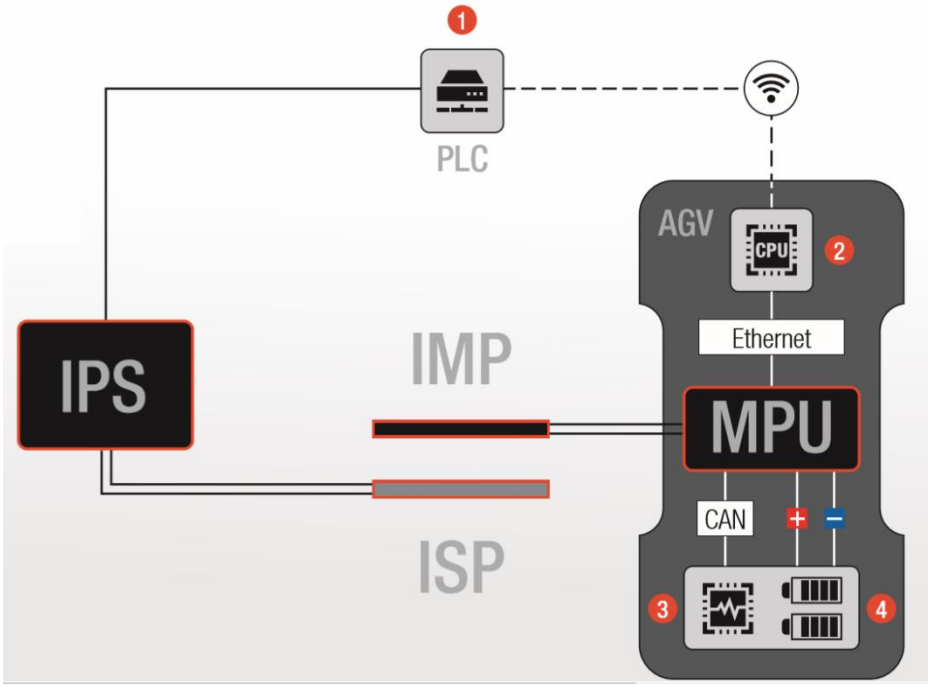

Fig. 6. General architecture of the elements

Electronic power units are required to convert the low-frequency mains current on the stationary side and to provide a stable direct current output to power an automatically guided vehicle [8].

3. Conclusions

The acquisition of AGV type transport-transfer equipment is a rather complex initial investment because it involves very high costs but the depreciation is done in a long time. A detailed analysis must also be performed to understand whether wireless charging can be a real advantage for the needs of the company.

In principle, the investment for automation in the transit area is a feature that is an advantage under certain conditions and depends on the total number of AGVs. For example, if for a logistics system that has 5 AGVs required to perform specific transfer-transport tasks, under the conditions of using wireless charging technology the number of AGVs can be reduced to 3 .

The wireless charging solution for automatically guided vehicles, regardless of the area in which they are used, is better than the traditional charging method, the charging time being considerably shorter and therefore the task fulfillment time is longer.

Although at the beginning the research in the development of the wireless charging solutions of the automatically guided vehicles used for the handling of goods in the production spaces and warehouses, one can notice sufficient advantages offered by the implementation of these new technologies.

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