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Drive-Through Covered Charging Station for Battery-Powered Vehicles

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ABSTRACT

The batteries of battery-powered vehicles can be charged with chargers that use mechanical contact plates which are prone to contamination and corrosion from the elements. Current hands-free charging mechanisms, while preferable, are not well suited for uncontrolled and unsupervised use in certain operating environments. This disclosure describes an outdoor contactless charging mechanism for vehicles powered by rechargeable batteries that addresses these issues. The mechanism employs a covered space with inductive charging primary antennas that are aligned with the vehicle secondary antennas with precision via a protected track with a center curb.

KEYWORDS

- Automated Guided Vehicle (AGV)
- Unmanned Guided Vehicles (UGV)
- Electric car
- Battery-powered automobile
- Robotic vehicle
- Inductive charger
- Contactless charging
- Construction site
- Center curb
- Drive-through charging

BACKGROUND

Rechargeable batteries are used to power many kinds of manned or unmanned vehicles, such as cars, Automated Guided Vehicles (AGVs), Unmanned Guided Vehicles (UGVs), robotic vehicles, etc. Apart from vehicles for general-purpose use such as automobiles, vehicles may be designed and employed for specific needs, such as construction support, public transportation, etc. Some of these vehicles may operate in harsh environments such as construction sites, that lack standard infrastructure such as paved surfaces. The batteries of battery-powered vehicles can be charged with chargers that use mechanical contact plates. However, contact plates are prone to contamination and corrosion from the elements, especially when the charging takes place outdoors. Therefore, a hands-free mechanism for charging the batteries of battery-powered vehicles is generally preferable. Such a mechanism can be unsupervised and a contactless mechanism can solve corrosion problems.

However, current hands-free charging mechanisms are not well suited for uncontrolled and unsupervised use in the operating environments of the vehicles. For instance, chargers with inductive charging require tight alignment with low tolerances that are difficult to achieve in real-world operating environments where surface traction may not be adequate. Overcoming these challenges with robust fault tolerance typically requires technicians specifically trained to maintain such robotic vehicles and their charging stations.

DESCRIPTION

This disclosure describes a contactless charging mechanism suitable for charging vehicles that are utilized in outdoor settings and are powered by rechargeable batteries. The mechanism employs inductive charging antennas that charge the vehicle batteries.

The charging antennas are mounted within an outdoors covered space with a center curb for guiding and parking the vehicle in place while it is being charged. Once the vehicle is in place horizontally aligned with the antennas on its either side, the charging antennas can move along the vertical axis to align in an optimal position in relation to the vehicle batteries. The vehicle can then remain in place until the batteries are charged using any suitable power source connected to the antennas, such as traditional electrical supply, solar power, etc.

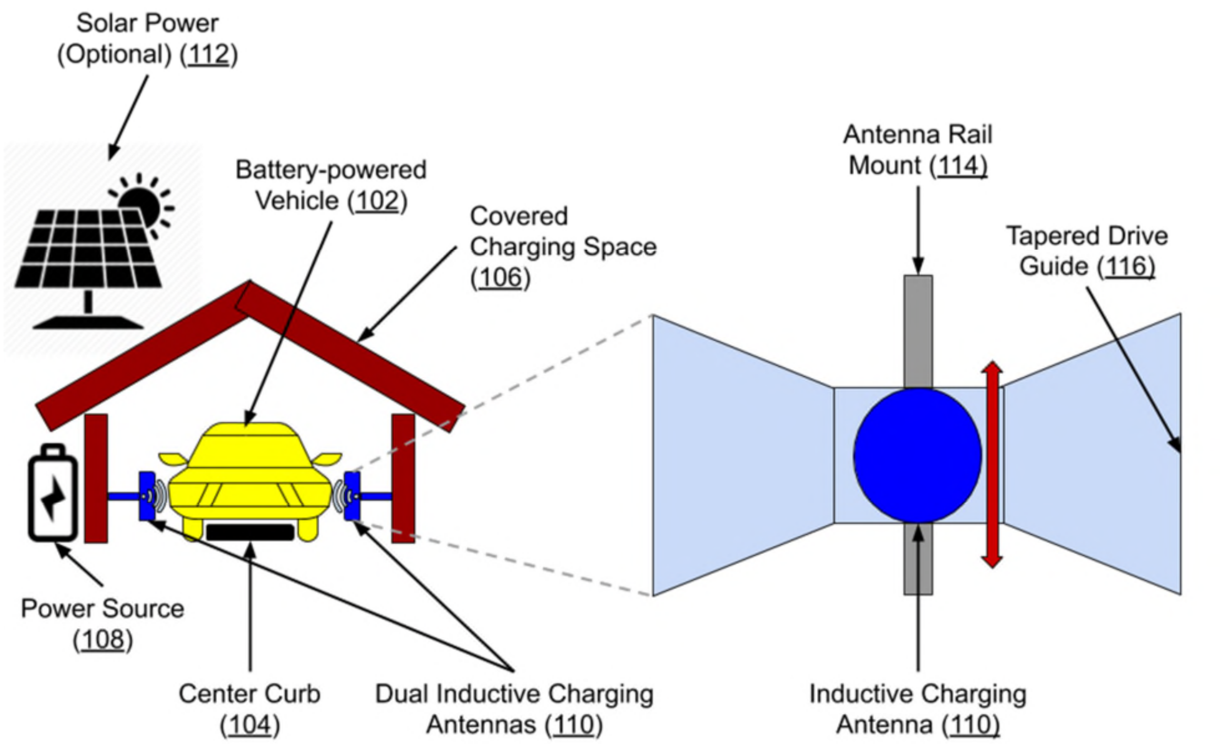

Fig. 1: Outdoor covered charging space with center curb and inductive charging antennas

Fig. 1 shows an operational implementation of the techniques described in this disclosure. A battery-powered vehicle (102) is guided into alignment with dual contactless inductive charging antennas (110) that are mounted within a covered charging space (106). A center curb (104) within the charging space is used to help achieve alignment between the vehicle batteries and the antennas along the direction of travel.

The antennas charge the vehicle battery via a suitable power source (108) or optionally via solar power (112), if available. Each inductive charging antenna can move vertically along a rail (114) guided by a tapered drive guide (116). The vertical positioning can align the antenna appropriately in relation to the vertical position of the vehicle battery.

The techniques described herein employ dual chargers to lower the amperage required per charger, thus reducing the risk of damage from overheating. The dual charger setup further provides protection against failures as the vehicle can charge at 50% charge rate even if one of the chargers and/or one of the receiving antennas of the vehicle fail and need repairs.

The inductive charging described in the disclosure does not suffer from corrosion problems and provides greater physical constraints against misalignment between vehicle secondary antennas and the charging primary antennas. The contactless nature of charging reduces the risk of damages caused by docking the vehicle at higher than permissible speeds, potentially resulting in forceful contact with the charger in the typical contact based charging mechanism.

The use of a covered space for the described charging operation reduces exposure of the charging equipment to the elements (rain, hail, ice, dust, etc.), thus making it water resistant. Moreover, the protected track within the covered space provides adequate traction which improves precision along the direction of travel of the vehicle. Further, the center curb can guide the vehicle into the appropriate place transverse to the direction of travel, thus achieving contactless charging with greater precision and supporting a drive-through operation.

The mechanism described in this disclosure can be used for charging the batteries of any vehicle powered by rechargeable batteries that can be charged with inductive chargers. While particularly suitable for automated vehicles that operate outdoors, the mechanisms can handle other types of battery-powered vehicles, such as indoor AGVs, robots, electric automobiles, construction-site transport machines, etc. Implementation of the techniques can streamline and automate the vehicle charging operation, thus raising efficiency, saving costs, and reducing the need for technician labor.

CONCLUSION

This disclosure describes an outdoor contactless charging mechanism for vehicles powered by rechargeable batteries. The mechanism employs a covered space with inductive charging primary antennas that are aligned with the vehicle secondary antennas with precision via a protected track with a center curb. The curb and vertical guides constrain the lateral axis, vertical axis, and rotation about the vertical axis of motion. The vehicle wheels control the longitudinal axis only. This reduces the complexity of docking to a single axis of motion. The inductive charging described in the disclosure does not suffer from corrosion problems and provides greater allowance for misalignment between the vehicle batteries and the charger. The use of a covered space for the described charging operation reduces exposure of the charging equipment to the elements. The mechanism described in this disclosure can be used for charging the batteries of any vehicle powered by rechargeable batteries that can be charged with inductive chargers. Implementation of the techniques can streamline and automate the vehicle charging operation, thus raising efficiency, saving costs, and reducing the need for technician labor.