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Differential Drive Cam-Over Lockout for Autonomous Mobile Robots

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Differential Drive Cam-Over Lockout for Autonomous Mobile Robots

ABSTRACT

This disclosure describes a differential drive cam-over lockout mechanism that enables the drive wheels of a vehicle such as an autonomous mobile robot or automated guided vehicle to be lifted off of the ground and the supporting swivel casters to be forced down to support the vehicle weight. This enables an operator to easily move an inoperable vehicle with human effort. The mechanism is actuated by a differential drive cam-over lockout mechanism that includes a block that can be mounted to the frame of the vehicle and supports a pivoting cam-over bar with a roller. Rotating the cam-over bar causes the roller to ride over the top surface of the pivot arm. The actuating force to rotate the mechanism is provided via a drive ratchet. The mechanism includes a ball detent to ensure that the cam-over bar stays in the stowed or locked position. The mechanism includes bushings and a roller to enable easy operation.

KEYWORDS

- Automated Guided Vehicle (AGV)
- Autonomous Mobile Robot (AMR)
- Differential drive
- Caster wheel
- Ball detent
- Pivot arm
- Drivetrain

BACKGROUND

Autonomous mobile robots (AMRs) and automated guided vehicles (AGVs) are commonly utilized at facilities such as warehouses and data centers. They are utilized for a variety of tasks and are capable of independently moving around in the environments where they are deployed. Most AMRs and AGVs utilize a differential drive mechanism that include a drive wheel and a caster wheel mounted to a pivoting arm or frame member. This type of design ensures that the drive wheels maintain contact with the ground on uneven surfaces.

AGVs or AMRs that break down, e.g., fail, run out of battery in narrow walkways, etc. can block access to critical equipment and pose a safe egress hazard. Most drivetrains (motor, gearbox, and wheels) do not have a mechanism to disengage the drive wheels. This makes pushing the AGV/AMR by hand very difficult. Even if the drive brakes include a manual release, overcoming system friction can pose a challenge. Additionally, manual releases are usually difficult to access and can hinder quick evacuation of the vehicle from the breakdown location.

DESCRIPTION

This disclosure describes a differential drive cam-over lockout that enables the drive wheels of a mobile robot (vehicle) such as an AMR or AGV to be quickly forced up off of the ground and supporting swivel casters to be forced down to support the weight of the mobile robot. When an AGV or AMR is inoperable, the differential drive cam-over lockout enables operator or maintenance personnel to quickly convert a difficult to move an inoperable vehicle into a configuration that is easy to move manually.

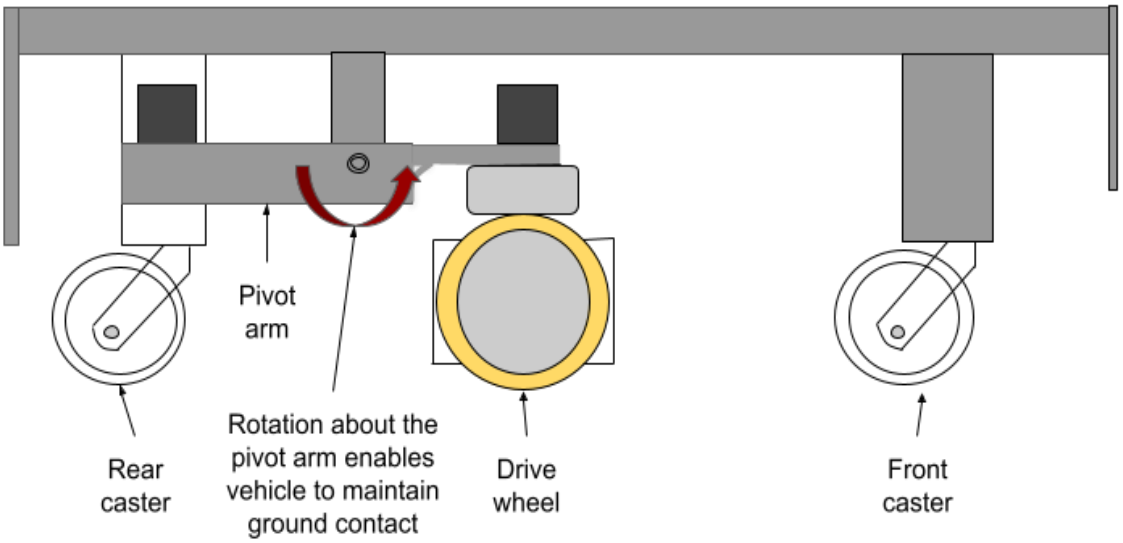

Fig. 1: Vehicle frame includes a drive wheel and a caster wheel mounted to a pivot arm

Fig. 1 depicts an example frame of a vehicle. As depicted in Fig. 1, the frame includes a drive wheel and a rear caster wheel mounted to a pivot arm. Such configuration enables the vehicle to maintain ground contact on all types of surfaces, including rough and/or uneven surfaces.

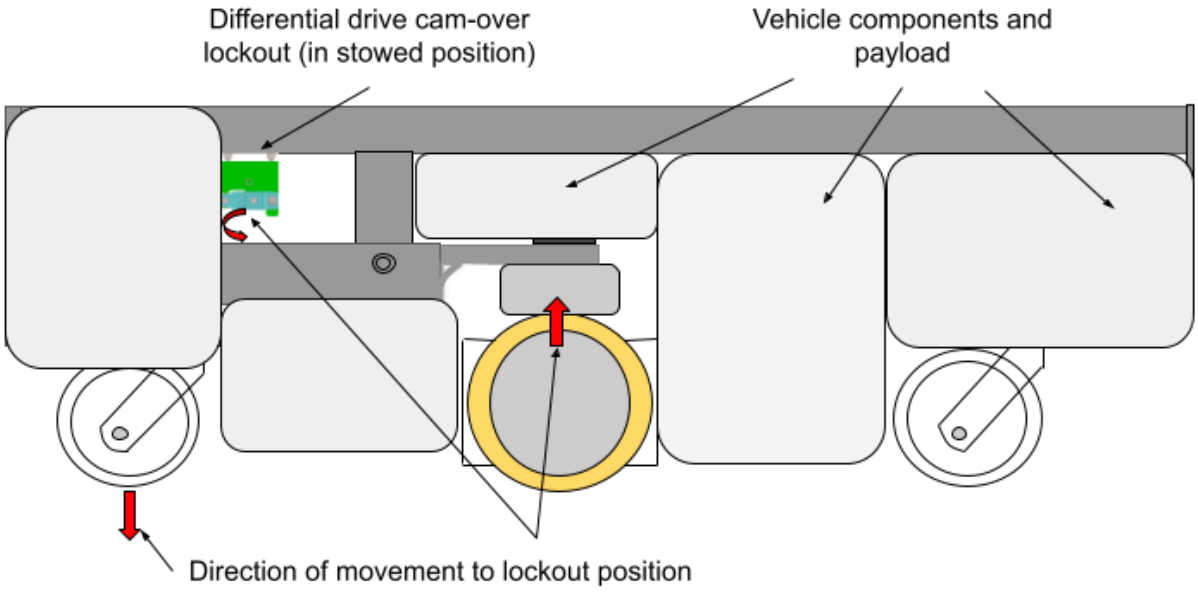

Fig. 2: A differential drive cam-over lockout mechanism enables the drive wheel to be lifted off the ground

Fig. 2 depicts an example vehicle that includes a differential drive cam-over lockout mechanism (assembly) mounted to the frame, per techniques of this disclosure. Additional vehicle components and/or payload attached to the vehicle frame are also depicted for illustrative purposes (not all components are depicted).

In Fig. 2, the differential drive cam-over lockout mechanism is shown in a stowed position. This position is reflective of normal vehicle operation when the drive wheels are in contact with the ground. At a time when the lockout mechanism is to be actuated, e.g., when the vehicle is inoperable and needs to be moved with human operator effort, the cam-over bar is rotated down towards the differential drive rotating arm. This causes a roller mounted to a lower surface of the cam-over bar to come into contact with the top surface of the pivot arm. This motion forces the swiveling caster down and the drive wheel up off of the ground, as depicted by red arrows in Fig. 2. Differential drive cam-over lockout assemblies can be provided on one or both sides of the vehicle for easy operator access.

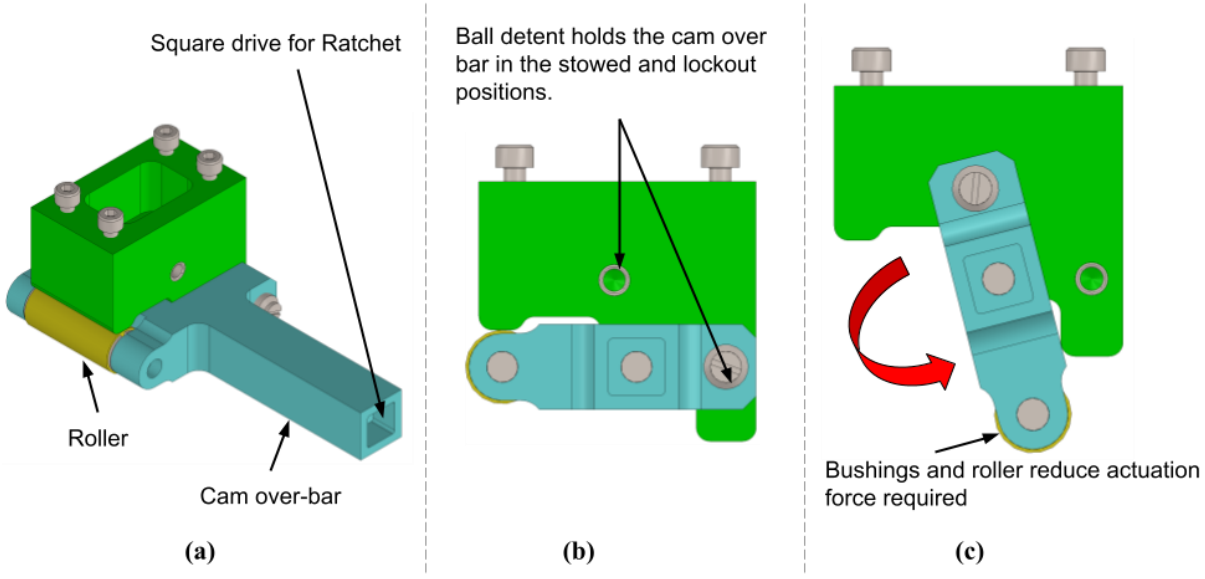

Fig. 3: Features of the differential drive cam-over lockout

Fig. 3 depicts multiple views of the differential drive cam-over lockout. Fig. 3(a) depicts a differential drive cam-over lockout mechanism that includes a block that can be mounted to the frame of the vehicle and supports a pivoting cam-over bar with a roller on it. The actuating force to rotate the mechanism is provided via a standard drive ratchet that can be inserted into the cam-over bar from the side of the vehicle without removing any parts of the vehicle. When the cam-over bar is rotated fully it is "cammed over" and any additional force applied to the bar only serves to keep it in its rest position.

The mechanism includes a ball detent, as depicted in Fig. 3(b) to ensure that the cam-over bar stays in the stowed or locked position. The actuating force is provided by personnel manually via a standard drive ratchet that can be inserted into the cam-over bar from the side of the vehicle without removing any parts. The mechanism includes bushings and a roller, as depicted in Fig. 3(a) and Fig. 3(c) that enable easy operation of the differential drive cam-over lockout mechanism. The differential drive cam-over lockout mechanism can provide sufficient drive wheel clearance when it is fully lifted, such that a vehicle of substantial weight can be actuated with relatively low amount of force.

CONCLUSION

This disclosure describes a differential drive cam-over lockout mechanism that enables the drive wheels of a vehicle such as an autonomous mobile robot or automated guided vehicle to be lifted off of the ground and the supporting swivel casters to be forced down to support the vehicle weight. This enables an operator to easily move an inoperable vehicle with human effort. The mechanism is actuated by a differential drive cam-over lockout mechanism that includes a block that can be mounted to the frame of the vehicle and supports a pivoting cam-over bar with a roller. Rotating the cam-over bar causes the roller to ride over the top surface of the pivot arm.

The actuating force to rotate the mechanism is provided via a drive ratchet. The mechanism includes a ball detent to ensure that the cam-over bar stays in the stowed or locked position. The mechanism includes bushings and a roller to enable easy operation.