Technical Disclosure Commons

Defensive Publications Series

October 18, 2017

Worm gear driven deployable structure for vehicle mounted camera system

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ABSTRACT

Vehicle roof mounted camera systems can collide with external structures with low height clearances. A stowable camera mast can help vehicles with roof mounted camera systems navigate structures and overhead obstructions (e.g., parking garages) by lowering the camera system to pass through without collision.

Electro-mechanical actuation can be employed to allow vehicle operators to deploy (e.g., raise) or stow (e.g., lower) the camera system from the ground level without having to climb onto the roof of the vehicle and manually change the position of the camera. The present techniques employ a worm gear and wheel gear driven mechanism to help vehicle operators deploy or stow the vehicle mounted camera system.

KEYWORDS

- Electronic actuation
- Vehicle mounted
- Camera
- Worm gear

BACKGROUND

Vehicle mounted camera systems can be mast mounted on to the roof of the vehicle. When vehicles with these camera systems pass through structures with lower height clearance (e.g., parking garages or awnings), the camera system may collide with or scrape the ceiling of the structure. Such incidents can cause damage to the cameras, sensors within the camera structure, the structure hosting the camera, the vehicle and/or the external structure/object.

DESCRIPTION

The described techniques employ a worm and wheel gear combination to drive the mast bearing the camera between a deployed position and a stowed position. Unlike in typical worm gear applications, where the wheel gear rotates, in the present mechanism the wheel gear is fixed while the worm gear rotates around the wheel gear. The camera mast, which is actuated by the worm gear, and the motor driving the worm gear both rotate around the wheel gear.

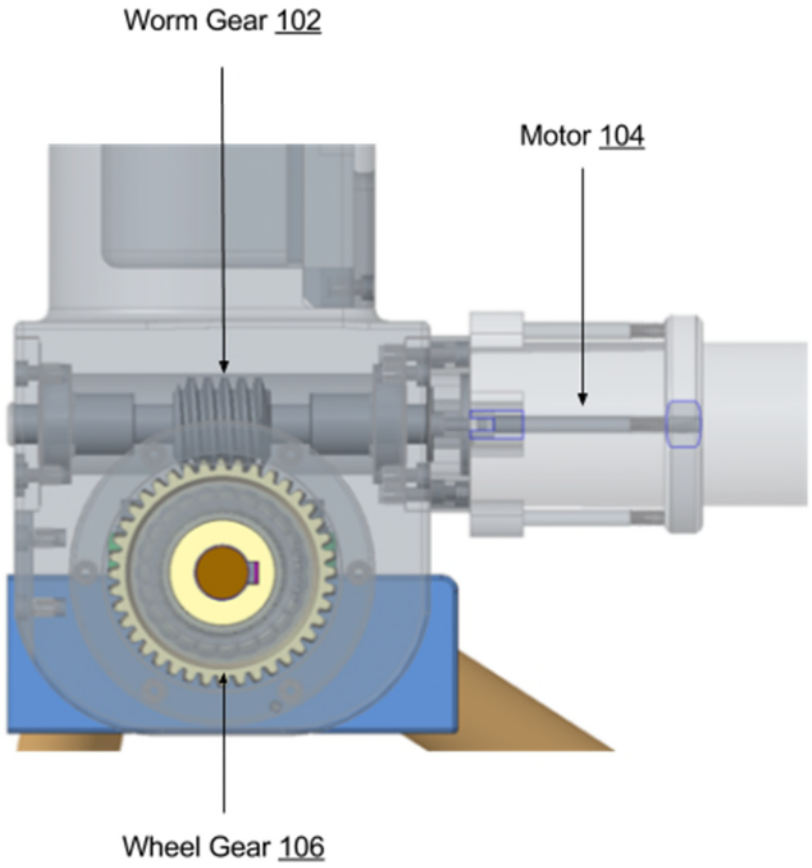

Fig. 1: Example motor driven worm and wheel gear combination in deployed state

Fig. 1 displays a worm (102) and wheel gear (106) combination driven by a motor (104). The advantage of rotating the worm gear for deploying and stowing a camera mast is that the angular range of travel of the worm gear system is not constrained by geometry. Other

mechanisms, such as linear actuator mechanisms, are limited in angular travel movements due to geometrical interferences.

The worm gear mechanism provides a larger range of motion (greater than 90^0) between the deployed and stowed states as well as a higher lifting capacity due to torque amplification of the gears. A range of motion greater than 90° allows the deployed section of the structure to be shorter, which is more structurally efficient. As a result, the camera system can be seamlessly raised (deployed) and lowered (stowed). Moreover, the worm gear holds the camera mast in place during normal driving conditions due to the locking aspect of the gear, e.g., no-back driveable trait of worm gears.

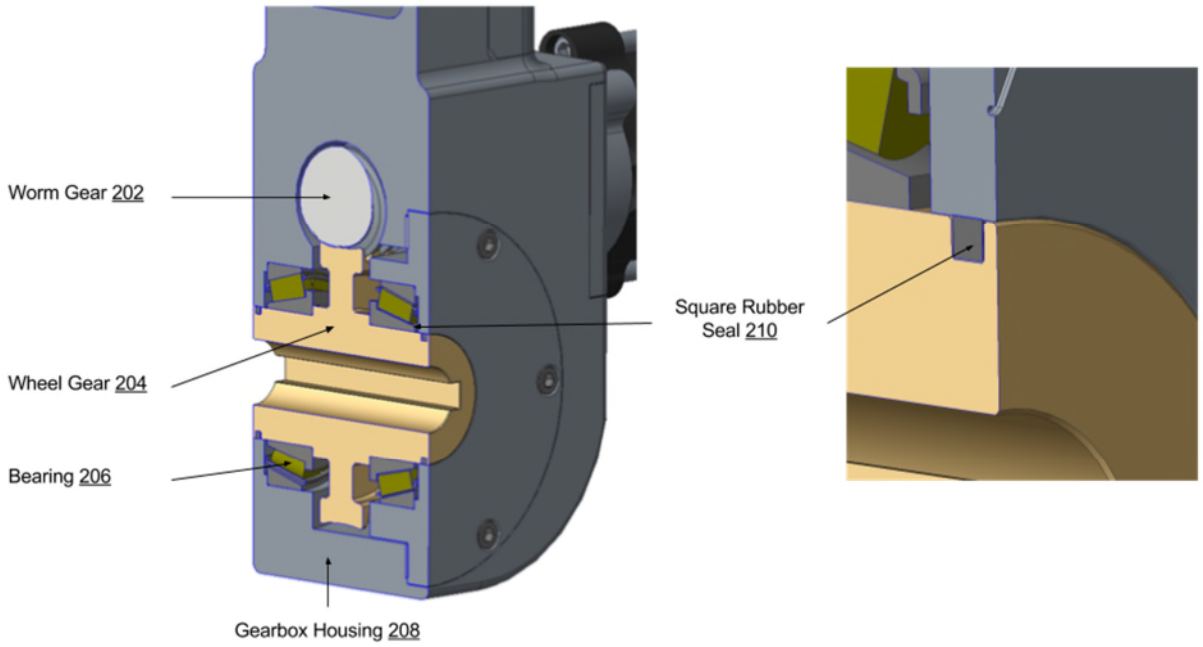

Fig. 2: Example gearbox and sealing mechanism

Another aspect of the worm gear drive system is the sealing method for the gearbox, with a sample arrangement shown in Fig. 2. Instead of typical shaft seals, square rubber seals (210) are used within grooves to seal the rotating worm gear (202) structure to the stationary wheel

gear (204). These square seals have the benefit of being much smaller than typical shaft seals, thereby reducing the overall size of the gearbox (208), and are a better sealing alternative to round o-rings, since the rotation speed is low.

As the drive mechanism (the worm and wheel gear combination) is enclosed within the camera mounted structure, only a single pivot point is used. The single pivot point allows the camera mast to break away during a collision, thereby limiting the force applied to the structure and vehicle.

CONCLUSION

The described techniques raise or lower a camera system mounted on to the roof of a vehicle using electronic actuation. This approach obviates the need for vehicle operators to climb on top of the vehicle to manually raise or lower the camera. The actuation is performed using a gear drive mechanism comprising worm and wheel gears. The gear mechanism provides the benefit of torque amplification for raising large loads (such as the camera system) while the worm gear helps lock the camera structure in place (due to no-back drive motion functionality) under normal driving conditions, and the single pivot point allows for breakaway functionality.