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Commentary

Note on Ackerman Steering Gear Mechanism

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DESCRIPTION

The Ackerman steering mechanism is a geometric arrangement of the linkages in the vehicle's steering system and is designed to rotate the inner and outer wheels at the appropriate angles. Ackerman steering is commonly used in vehicles for better handling. Early versions of steering have changed over time to electronic and hydraulic steering systems, but the basic principles are same.

According to Ackerman, there is a momentary midpoint where all tyres rotate at different angles. The left front tyre has a larger angle of rotation than the right front tyre. Similarly, the two rear tyres form different angles, creating four different radii for the four tyres. Therefore, the tyre on the other side of the corner travels a longer distance than the tyre on the other side. For this reason, the right tyre spins faster than the left tyre.

The steering gear mechanism [1] is used to orient two or more wheel axles with respect to the chassis to move the vehicle on any path. Normally, the two rear wheels have a common axis, are directional with respect to the chassis, and steering is done by the front wheels [2]. In a car, the front wheels are placed on the front axis, and the front axles are connected at two points. These points are connected to the chassis. The rear wheels are located on the rear axles at both ends of the differential tube. As the vehicle spins, the front wheels rotate around their respective pivots along with their respective axis. The rear wheels are straight and do not rotate. Therefore, steering is done only through the front wheels.

WORKING

The Ackerman steering principle is simpler because it uses tyre rods and fixed links of various sizes to ensure correct vehicle handling [3]. The difference in length between the fixed link and the active link is adjusted using the active link. The shorter the tyre bar length, the more concentrated the tilt link will be on the rear axis. Therefore, when turning a car, the slip angle differs for each tyre, making it easier to turn. In addition, the tilting force automatically returns the handle to the center and rotates correctly at various angles. The car uses the principle of Ackermann steering. The idea behind Ackerman steering is that the inner wheels rotate at a greater angle than the outer wheels, allowing the vehicle to rotate around the midpoint of the rear axis.

ADVANTAGES

Usage of the Ackerman principle on the steering system makes a unique system known as the Ackerman steering mechanism. There are multiple benefits of having an Ackerman steering system contrary to hydraulic or power steering systems [4].

- It prevents tyre from slipping outward while turning the vehicle.
- It increases the controllability of vehicles by using shorter tyre rods.
- Ackerman steering geometry makes the tyre toe-out which enables them to easily drive through steep manoeuvres [5].

CAR BODY TYPES AND USAGE OF ACKERMAN

Car body type is one of the main factors supporting the use of the Ackermann steering principle in the vehicle. The steering mechanism is designed to operate with slow Ackerman or parallel steering. Sports cars and high-speed cars use parallel steering, but sedans prefer Ackerman. However, racing cars use the reverse Ackermann principle to avoid additional stress on outer tires that are already suffering from additional centrifugal force. Additional load and temperature can cause wear and tear of the tires, which troubles on the racing track.

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