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Four Wheel Steering System

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Abstract: Quadra steering system is also known as a four wheel steering system.In this document, both front and rear wheels can be steered according to vehicle speed and available space for turning.Quadra steering system provides greater ease for vehicles when driving at low speed increases handling, stability and control at higher speeds.Quadra steering system operates in negative phase, positivephase and neutral phase.This allows for steering the car into smaller parking spaces and more stable in speed.This makes the car more efficient and secure when it comes to cornering, making it easier and quicker to change lanes.The main goal is that the driver shouldn't need further effort to turn the car.Four wheel steering is a system developed in the automotive industry for efficient vehicle turning and manoeuvrability.The rear wheels do not turn in the direction of the curve in a traditional front wheel steering system, hence it creates curb in the steering. In four wheels steering the rear wheels turn with the front wheels and thus improve the vehicle's efficiency.

Keywords: Negative Phase, Neutral Phase, Positive Phase, Quadra, Steering System, Wheel.

INTRODUCTION

The vehicle with higher track width and wheelbase faces turning problems in city driving conditions as the space is limited; the same issue is faced in low speed cornering.Four-wheel steering of the vehicle, which is effective in confined space, reduces the turning radius.In situations such as parking for cars, low speed cornering and driving in city areas with heavy traffic in tight spaces, driving is very difficult due to the greater track width and wheelbase of the vehicle.There is a need for a system that results in less turning radius and that can be accomplished the implementation of four wheel steering[1].

Rear wheels are steering relative to the front wheels depends on the operating conditions. When low-speed wheel rotation is pronounced and rear wheels are steered in the opposite direction to front wheel movement. This is also simplifies the car positioning or car parking in a confined space. The rear wheels are designed to follow the path taken by the front wheels on the lane, the rear of a 4WS car does not turn as normal. Hence the chance of reaching an obstacle is reduced considerably.When front wheels and rear wheels at high speed turn in the same direction, the steering changes are slight[2]. The car is running crab-like way rather than in a curved line. This action is advantageous to the car when changing lanes on a high-speed road.Eliminating the centrifugal impact as a result reducing body roll and cornering force on the tyre, increases the car's stability so that control is simpler and more stable.The control of drive angle at front and rear wheels is most important in a four wheel steering system[3].It has full independent steering and need to turn in an unconventional direction to ensure the vehicle is turning on its own axis.Such a system requires accurate calculation from a servo motor with real-time feedback to make sure all three steering modes are working perfectly.The major problem this configuration presents is that a traditional pitman-armed rack-and-pinion steering would not be ideal for this design, since the two front wheels are steered in opposite directions[4]. Figure 1 shows the four wheel steering system.

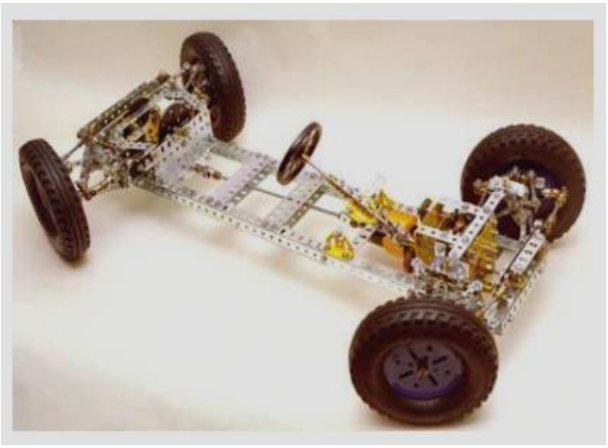

Figure 1: Four Wheel Steering System

1. *Phases of Quadra Steering System:*

Quadra Steering is the system that gives vehicles of full size greater ease or manoeuvrability while driving or tugging on low speed and improves handling, stability,

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and control at higher speeds.Steering system works mechanically with help of linkages.The system uses a manual manipulator for regulating and guiding rear wheel articulation.The system operates in three stages: - Negative, Positive and Neutral[5].

a. Negative Phase:

In this drive the front and rear axles move in opposite directions relative to one another. This drive is used primarily during vehicle parking.As both axles move in different directions the curvature radius is reduced while turning.The vehicle will need fewer parking spaces and that will be helpful in places where traffic and parking is a major problem[6]. Figure 2 shows the negative phase of four when steering system.

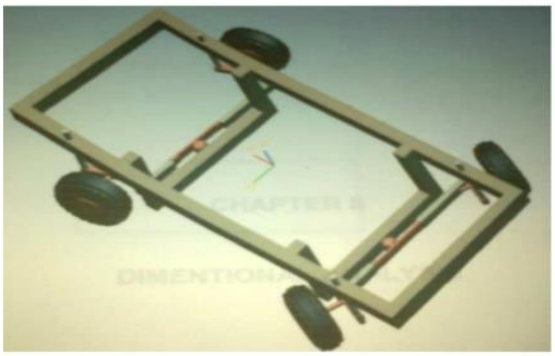

Figure 2: Negative Phase of Four Wheel Steering System

b. Positive Phase:

In this drive both the axle i.e., front and rear move in same direction relative to the each other.The front and rear axle allows the Quadra steering system to change the lane when driving on the highway. This is normally implemented at greater speed[7]. Figure 3 shows the Positive phase of four when steering system.

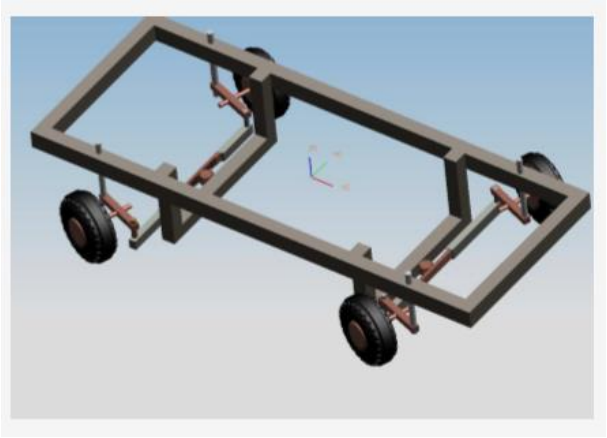

Figure 3: Positive Phase of Four Wheel Steering System

c. Neutral Phase:

Front axle moves in this drive either in the direction of the clockwise or anticlockwise direction and the rear wheel is unmoved.The move sees in every four wheelers in day-to-day life. It is generally used at moderate speed[8]. Figure 4 shows the Neutral phase of four when steering system.

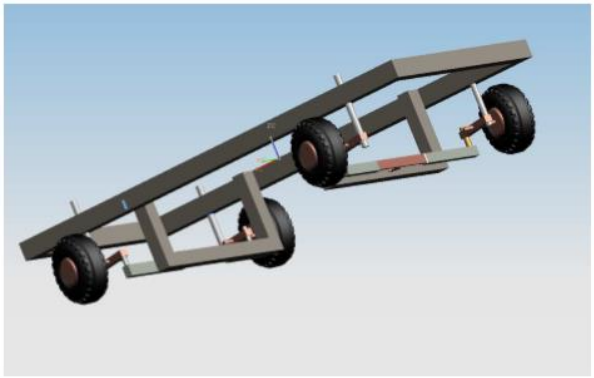

Figure 4: Neutral Phaseof Four Wheel Steering System

STEERING PRINCIPLES AND COMPONENTS

1. Ackermann Steering Mechanism:

For perfect Ackermann, the middle point of all the circles traced by all wheels should lie at a common point at any angle of steering. But in practice, this can be hard to arrange for simple linkages.Modern cars do not use pure Ackermann steering, partly because it lacks essential

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dynamic and compliant effects, but the concept for low speed manoeuvring is valid[9].

2. *Turning Radius:*

A vehicle's turning radius is the radius of the smallest circular turn (i.e., U-turn) that the vehicle can make. The term turning radius is a technical term which has become a common terminology in the automotive industry.In the jargon sense, it is generally used to indicate the diameter of the smallest circle but the turning radius is still used to describe the radius in scientific use.

3. *Steering Ratio:*

The steering ratio is the number of degrees the steering wheel has to turn to pivot the front wheels 1 degree. Example: steering ratio 18:1 implies that when the steering wheel turns 18 degrees, the front wheels turn by 1 degree.The steering ratios commonly used in steering gears range from approximately 12:1 in cars to approximately 35:1 in heavy vehicles.an average overall ratio gives about one and a half complete turns of the steering wheel on each side of the mid position to apply 45 degree lock to the wheels.

4. *Turning Circle:*

The turning circle of the car is the circle diameter defined by the external wheels when turning on full lock. There is no hard and fast formula to calculate the turning circle but an approximate value can be obtained.

5. *Steering Geometry:*

If a car moves along a curve, all its wheels should truly roll without any lateral slip. This can be done at one point axis of all four wheels are intersects. This point will be the centre of the vehicle's turn at that moment. Two circles rotate the rear wheels. 1 and 2 front wheels have separate axles. Two other circles rotate with the same centre point.

6. *Vehicle Dynamics and Steering:*

Vehicles dynamics are very critical for a balanced vehicle push. It can be in three directional terms: under-steering, over-steering, and neutral or counter steering.

COMPARED OF 4WS SYSTEM WITH 2WS CONVENTIONAL SYSTEM

In a two wheel steering vehicle, only two of the four wheels actually rotate and drive the car forward.It may be either rear wheel drive or front wheel drive.In a four wheel steering vehicle, all four wheels are powered.Figure 6 shows comparison of avoidance manoeuvre through a vehicle with two wheel steering system conventional steering.

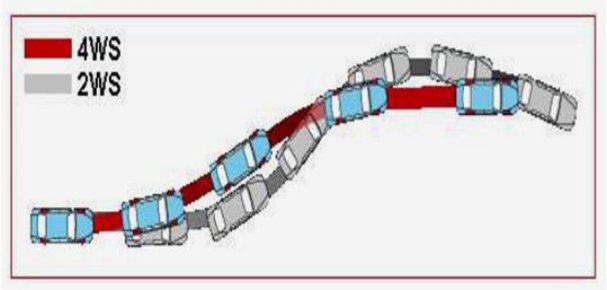

Figure 6: Comparison of the Avoidance Manoeuvre with a Vehicle with 2WS Conventional Steering

FUTURE ASPECTS

An innovative aspect of this steering link design is its ability to use a single steering actuator to drive all four wheels.Its successful implementation will allow for steering power base with maximum manoeuvrability, development of a four-wheel, uncompromising static stability, optimum obstacle climbing capacity and front and rear wheel tracking. The advanced four wheel steering system will work with the help of the microprocessors electronically.The machine will use an on-board computer to control and steer the rear wheels to turn left and right[10].

CONCLUSIONS

The four wheel steering system has cornering capability, steering reaction, straight line stability, lane change and manoeuvrability at low speeds. It is advantageous over the two-wheel convectional steering system, four-wheel steering is complex and expensive.The expense of a four-wheel driving vehicle is more than that of the convectional two-wheel steering.Four wheel steering is increasing in popularity and more and more new vehicles are likely to come in.The cost of four wheel steering system will drop as the system becomes more commonplace.The four wheel steering system works mechanically with help of linkages. The control of drive angle at front and rear wheels is most important in a four wheel steering system. Four-wheel steering of the vehicle, which is effective in confined space, reduces the turning radius.In situations such as parking for cars, low speed cornering and driving in city areas with heavy

traffic in tight spaces, driving is very difficult due to the greater track width and wheelbase of the vehicle.

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