

All Wheel Steering Mechanism

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Abstract: When we go to check the vehicles, most of the vehicles now a day are using two-wheel steering system. The problem in two-wheel steering system is that there is requirement of more turning radius to turn the vehicle. But if we talk about the efficiency, we get to know that two wheels have low efficiency as compared to four-wheel steering system. So, if we use four-wheel steering system instead of two-wheel steering system we can improve efficiency as well as can decrease the turning radius of the vehicle. Four-wheel steering system is only method to overcome the problem of over steering and under-steering. The purpose of this project to make all four wheels movable simultaneously. In this we have used linkage mechanism to move all wheels of the vehicle. We use Ackerman steering system at both front and rear wheel for steering system in the vehicle. We connect both the Ackerman steering by link mechanism to change the angle of rotation of vehicle. All wheel steering system can be employed in some vehicles to improve steering response, increase vehicle stability while moving at certain speed, or to decrease turning radius at low speed. It enables the car to be steered into tighter parking spaces.

Keywords: Four-wheel steering (4ws), Crab Steer, Rack and Pinion, Spur Gear

I. INTRODUCTION

Steering is a method that is used to control the movement of vehicle but if we talk about the four-wheel steering system, we get to know that nowadays most of the cars are using two-wheel steering system. But as we compare it to Four-wheel steering system, we get to know that the efficiency will be more in four-wheel steering system and we can get low turning movement by the help of four-wheel steering system. In four-wheel steering system, rear wheel also turns rather than just follow the front wheel. As in four-wheel steering system both front axle and rear axle moves as per the requirement of the operator of the vehicle. Four-wheel steering is new technology related to steering system to improve the steering system in four-wheel vehicles.

At high speed, when steering adjustments are subtle, the front wheels and the rear wheels turn in the same direction. By changing the direction of the rear wheels there is the reduction in the turning radius of the vehicle which is efficient in parking, low speed cornering and high-speed lane change. Four-wheel steering reduces the turning radius of the vehicle which is effective in confined space, in this project four-wheel steering is adopted for the existing vehicle and turning radius is reduced without changing the dimension of the vehicle. Two-wheel steering system is able to control the vehicle but it is not enough to drive the vehicle in small, narrow space or in traffic. So, this project relies on this concept and has four wheels steering to control the vehicle in almost all condition. From past research, we are going to improve steering by combining 4WS and 2WS systems. In this project, the rear wheels are disengaged from the front wheels at a high speed and at a low speed both front and rear wheels are steered the vehicle. In our project we have tried to keep the mechanism as much mechanical as possible which can be easy to manufacturing and maintenance as well as easy to operate. All wheel steering improves the stability and handling of vehicle while taking sharp turns. In that steering system, the all wheels are to be steered according to the steer perform to drive towards left or right.

II. LITERATURE SURVEY

K. Lohith et al. [1], gives the comparison between the turning radius for two-wheel steer and four-wheel steer by calculation and experiment. By calculation we can conclude that there is 41.13% reduction in turning radius and by experiment it's 50.43%. The information put above clearly states that 4 Wheel Steering has many advantages and it can truly become a successful replacement for 2-Wheel steering system. But its design is so expensive that automotive manufacturers have not yet arrived at an economical solution. It is incepted in Jeep

Hurricane, Lexus GS and other high-end automobiles. Thus, the four-wheel steering system has got cornering capability, high steering response, straight line stability, lane changing and low speed.

R. Masilamani et al. [2], The work deals with the design and analysis of steering gear box using planetary gear set. The concept has been developed to reduce the driver's effort during parking or maneuvering sharp curves. Steering ratio decides how far the driver has to turn the steering wheel to get the wheels to turn a given distance. Using the additional planetary gear set with the existing steering gear box, steering ratio can be changed and hence the input speed to the steering wheel can be altered when to the steering gear box.

H. A. Hussain et al. [3], they used rack and pinion (spur gear) arrangement. There are two steering racks mounted at front side and rear side on the frame. Both steering racks spindle having pinion which are connected by the rack. The rack is mounted in such a way that it should mesh both front and rear steering racks pinion. This cause transfer of motion from front steering rack to rear steering rack. As a result, all wheels are steers simultaneously.

Vaghela Rinkesh et al. [4], the fabrication of four-wheel drive is generally mechanically driven, which causes lots of effort so, there is hydraulically actuated four-wheel drive then it gives number of benefits. We cannot replace whole steering system so; we make a system which does the four motions. Such as zero turn, Crab steer, sharp turning and two-wheel steer etc. Commonly in all four-wheel steering mechanism two-wheel steering mechanism is used i.e., Ackermann steering mechanism and Davis steering mechanism. By using this type of steering mechanism in the four wheel only front wheel steer whether front wheel or rear wheel mostly the front wheel.

Naveen Kumar et al. [5], the detail about the Four-wheel steering system used in Automobile Industry. The Steering System is the most Important part of a vehicle for providing a desired path. Today, almost every vehicle uses the Conventional Two Wheel Steering to get control of Vehicle if it is Rear wheel drive or Front wheel drive. Two Wheel Steering System is less stable than Four Wheel Steering System. From now on due to Safety Reasons, Four Wheel Steering is introduced in some Vehicles, which provides better Stability and Control at Higher Speeds. It also helps the vehicle to make very sharp turns. Basically, Four-wheel Steering System is used to minimize the turning radius. It is a solution to over steer/under steer and It has Excellent maneuverability or Flexibility.

III. OBJECTIVES AND METHODOLOGY

3.1 Objectives

The main objectives of this project are as follows:

- To learn about the different components used in the steering system of automobile.
- To know how a vehicle is being steered with conventional steering system.
- To find out the alternative way for steering a vehicle in an efficient way within a less turning radius and usually while parking the vehicle.
- To know how a four-wheel steering system actually works.
- To study the mechanism used in simultaneous turning of all four wheels of automobile.
- To save the area for turning and the power applied by the driver.
- To make the vehicle reverse or to turn it through 360o by four-wheel steering system.
- To practically enhance the knowledge about the automobile.
- To learn how to modify the existing engineering model so as to make its performance better and increase its efficiency.

3.2 Methodology

- For building of prototype model, the designed model is considered along with that a frame is built to support the steering, wheels and seat. According to the design, the mild steel bars are cut and welded together to make the frame.
- Rack and pinion mechanism is constructed using chain and sprocket where, chain works as rack and sprocket acts as pinion in the system. The rack made is constructed inside a mild steel bar and welded into the system on front and rear side by a distance of required wheelbase.
- Wheels are attached into the system via tie rod and further tie rod is welded to the rack of the system.
- Transmission system is constructed with the help of a transmission rod and sprockets welded on both end of the rod. It is attached to the system using bearing systems.
- Steering system is attached to the framework through the bearing connecting a sprocket which is used to steer the system.

IV. WORKING PRINCIPLE

As shown in Fig. 1 CAED model of the system, the steering wheel rotates to take turning, all wheels are steered. This happens because the motion of steering wheel transfer to steering rack, the steering rack's spindle joint by the pinion called as (spur gear). There is also another steering rack mounted at the rear side of frame which also contain the pinion. Both steering pinions are connected by the rack called as design rack. The design rack should mount in such a way that, it should transfer the motion from front pinion to rear pinion. This helps to steer the front wheel and rear wheel in opposite direction. Result in less turning radius. There is also axle available mounted at the rear side of frame to give motion to the vehicle. The system is pedal operated.

Once the all four wheels of the vehicle get coupled to the steering wheel the steering wheel does its function and makes all the four wheels of the vehicles to steer simultaneously and the operation of four-wheel steering is performed. Once this process is over the wheels are brought back again to the straight position and the lever is pulled down to disengage the rear steering mechanism with the steering wheel and the vehicle again becomes anormal two-wheel steering system. The Components used for the project are as follows;

- Basic frame
- Rack and Pinion Mechanism
- Chain
- Sprocket
- Bearing
- Transmission Rod
- Tie Rod
- Wheels
- Steering

All the pictures given belows shows the components and the fabricated model of the project. Fig. 2 shows the frame work of the system which is the structure of the system. Similarly, Fig. 3 shows the rack and pinion mechanism created using chain as rack and sprocket as spinion in the system. Fig. 4 shows the bicycle hub which is used as tie rod to the system. The main purpose of it is to hold the wheels to the frame and change the inclination angle of the wheel when the vehicle is steered. The wheel shown in Fig. 5 is a bicycle wheel which is used in the system. Since, the weight of these wheels is less compared to cars wheels so it is easy to for the system to steer the wheels without help of any transmission or hydraulic steering mechanism. As shown in Fig. 6, transmission rod, drive shaft or Propeller shaft is a mechanical component for transmitting torque and rotation, usually used to connect other components of a drive train that cannot be connected directly because of distance or the need to allow for relative movement between them. A steering wheel (also called a driving wheel, a hand wheel, or simply wheel) is a type of steering control in vehicles is shown in Fig. 7 below. The steering wheel is the part of the steering system that is manipulated by the driver; the rest of the steering system responds to such driver inputs. Fig. 8 shows the picture if complete fabricated all wheel steering mechanism project.

V. FIGURES

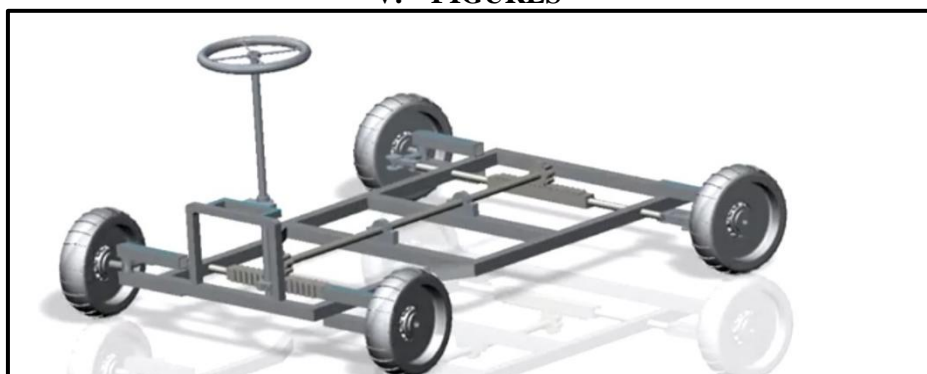


Fig. 1 CAED Model of Project



Fig. 2 Framework



Fig. 3 Rack and Pinion Mechanism



Fig. 4 Tie Rod



Fig. 5 Wheel



Fig. 6 Bearing and Transmission rod



Fig. 7 Steering Wheel



Fig. 8 Completed Fabricated Project Model

VI. CONCLUSION

A vehicle with higher turning radius face difficulty in parking and low speed cornering due to its higher wheelbase and track width, in this scenario zero turning steering will be effective as the turning radius of turning decreases time required for turning the vehicle and path which the vehicle covers while taking turns decreases. The zero turning vehicles are designed such a way that it can be changed from four-wheel steer to two-wheel steer whenever required. This four-wheel steer is designed only for the parking purpose, so when the vehicle has to move at a speed higher than 10 kmph it has to be in two-wheel steer so the vehicle will be designed such that it can be converted to four-wheel steer in parking and again back to two-wheel steer.

As per the focus of the project we have created an innovative 4-wheel active steering mechanism which is feasible to manufacture, easy to install and highly efficient in achieving in-phase and counter-phase rear steering with respect to the front wheels. This system assists in high-speed lane changing and better cornering. It combats the problems faced in sharp turning. It reduces the turning circle radius of the car and gives better maneuverability and control while driving at high speeds, thus attaining neutral steering.

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