

Review on Four Wheel Steering System

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Abstract— This Review Paper provides 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. Due to Four wheel Steering, driver can control the Vehicle very easily in various conditions and it also decreases the effort of Driver.

Keywords: Four Wheel Steering System

I. INTRODUCTION

The Term Steering can be defined as the collection of Components, Linkages and some other Parts etc. which permits the vehicle to take the desired path.

Only the Rail Transport is the exceptional case in which rail tracks are put together and get combined with Railroad switches, provides the steering control to vehicle.

Today, the current arrangement in the steering system is to rotate or turn the front wheel by steering which is controlled by the driver using hands and is set up in front of the driver, via the steering Column, which consists of any other automobile part or uses Universal Joints specifically, to permit driver to deviate the wheels from its original position.

Some Vehicles such as Tanks, Heavy Load Trucks and Bulldozers uses Differential Steering in which tracks are built in such a way it moves at distinct speed or even in different directions, uses parts such as brakes and clutches, to bring the change in direction.

II. LITERATURE REVIEW

A. Design and Development of Active Four Wheel Steering System [International Journal of Innovative Research in Science, Engineering and Technology (IJIRSET) Volume 5, Issue 4, April 2016]

Author Name – Ketul B. Patel, Nirmal M. Patel, Akshay S. Patel, Ujas R. Patel, Diptesh Patel

Mechanism – 4 Wheel Steering Mechanism

Efficiency – It is high in comparison to Two Wheel Steering System.

Applications – Increased Maneuverability, stability, turning radius and Driver Effort.

B. Four Wheel Steering - Review [JournalNX – A Multidisciplinary Peer Reviewed Journal. Volume 4, Issue 9, September 2018]

Author Name – Pranita Padwal, Sukruti Pandit, Denisha Vachhani, Prof. Sumit Dharmarao

Efficiency – Efficiency is High

Applications – Use of Complete Mechanical System with Spur Gears is Done. Durable and reliable. Maintains the stability of Vehicle in High Speed Conditions.

C. Prototype of Four Wheel Steering System [Advances In Materials And Manufacturing Technology. Volume 4, Issue 10, October 2015]

Author Name – Chanpreet Singh, Dr. Rupesh Gupta, Himanshu Jindal, Rajeev Kumar Dang

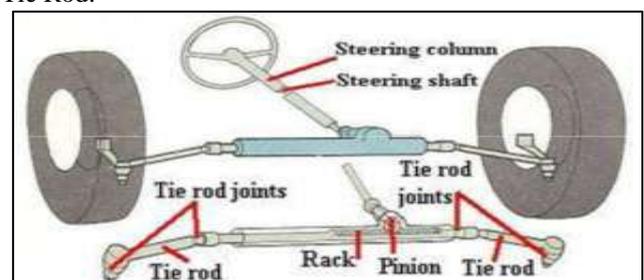
Efficiency – Efficiency is High

Applications – The Whole Prototype which is proposed in this paper can be moved in 360° Direction on its own position.

III. WORKING OF EXISTING STEERING MECHANISM

In Present time, Automobile Industries uses Ackermann Mechanism and various parts are used for the assembly of Steering System like Steering Wheel, Tie Rod, Steering Column, Rack and Pinion etc.

When Steering Wheel is Rotated, Steering Column is also rotated. At the last side of the column, steering gear box is equipped or fitted. Due to this, oscillation of cross shaft occurs in the gearbox when the steering wheel get rotated by driver. Cross Shaft is linked or joined to Drop Arm. This is joined by mode of a Drag Link to the Steering Arm. The Steering Arms are linked or joined by Tie Rod to Drag Link on both Wheel. The wheel moves left and right direction when the steering wheel is rotated, the knuckle also shifts backward & forward. At the end of Knuckle, connection of Tie Rod is done. End of Drop Arm is linked to end of one of the Drag Link and the Other end is joined by some means to Tie Rod.



IV. STEERING FUNDAMENTALS AND COMPONENTS

A. Ackermann Steering Mechanism

When a wheel is taking a turn, the front inner wheel needs to turn at different angle to the front outer wheel because they

are turning at a distinct radii. The Ackermann steering mechanism is the arrangement of linkages in the steering system of a vehicle which is designed in such a way that it turns the outer and inner wheels at Convenient angles.

B. Steering Ratio

It is defined ratio of Number of Degrees of rotation of the Steering Wheel to the number of degrees of wheel rotation as a result. For Example, if steering wheel completed its one turn, i.e. 360 degrees, results in turning the wheel to turn 30 degrees, then the ratio is 360:30 = 12:1.

Steering Ratio is directly Proportional to Driver's Effort. Higher the Steering Ratio, less will be the effort. Lower Steering Ratio means Effort will be more.

C. Turning Circle

Turning Circle of a Vehicle is the Diameter of circle made by outside wheel when turning on full lock. Turning Circle can be obtained by using this formula:

$$\text{Turning Circle Radius} = (\text{Trackwidth})/2 + (\text{Wheelbase})/\text{Sine}(\text{Average Steer Angle})$$

V. VEHICLE DYNAMICS

It is Very important for a balanced drive of a vehicle.

A. Under-Steer

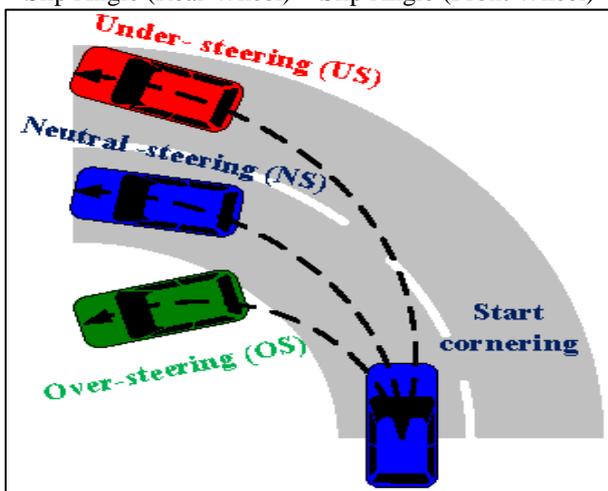
- This condition occurs when rear wheel Slip Angle is less than front Wheel Slip Angle
Slip Angle (Rear Wheel) < Slip Angle(Front Wheel)
Slip Angle = It is the angle between direction in which it is actually travelling and the direction in which the vehicle wheel is pointing.

B. Over-Steer

- It occurs when Rear Wheel Slip Angle is greater than Front Wheel Slip Angle.
Slip Angle(Rear Angle) > Slip Angle(Front Wheel)

C. Neutral or Counter Steering

- It occurs when Rear Wheel Slip Angle is equal to Front Wheel Slip Angle.
Slip Angle (Rear Wheel) = Slip Angle (Front Wheel)

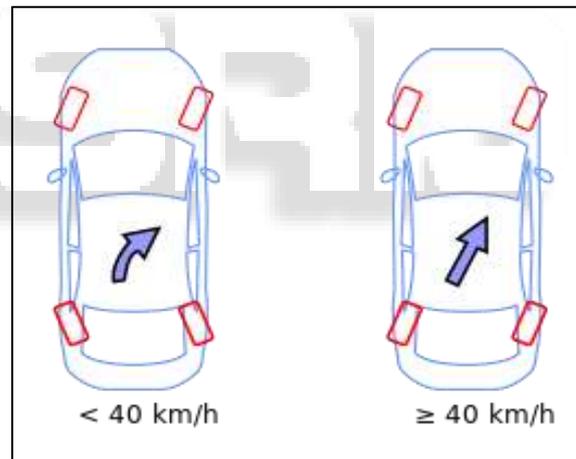


VI. WORKING OF FOUR WHEEL STEERING

Four Wheel Steering (4WS) or All Wheel Steering or Rear wheel Steering which provides control to driver to easily steer the front or the rear wheels during Turning. In this Steering, all four wheels move according to the applied geometry for four wheel steering. This term should not be confused with Four Wheel Drive in which all the four wheels of vehicle are powered by Engine. Due to this, Handling of the steering wheel gets smoothen or improved and it helps the vehicle to make tighter turns. The rear wheels generally does not rotate like the front wheel, but due to their movement turning circle diameter gets reduced as much as 1 Meter.

At slow Speed, both Front wheels and rear wheels turns in different directions. This movement helps in the positioning of a Vehicle in conditions such as confined space parking or to take a turn in less space. Since the rear wheels takes the path followed by the front wheels on the road, the 4WS vehicle does not turn in a regular way. So, problems like hitting an obstacle or an object gets reduced.

At Greater Speed, both front & rear wheels turn in same direction. Due to this movement, vehicle moves or travels in a manner like a crab rather than the curved path. This helps in lane changing on a busy road. The elimination of effect of centrifugal force occurs, which results in decrement of Cornering Force and Body Roll on tire, which improves stability of Vehicle so that control on Vehicle becomes safer & easier.



VII. ADVANTAGES & DISADVANTAGES OF 4 WHEEL STEERING

A. Advantages

- 1) At slow Speed, Vehicle gets more Stable
- 2) High Speed Straight Line Stability
- 3) Accurate Steering Response
- 4) Smaller Turning Radius
- 5) Easier to turn Vehicle in narrow road.
- 6) Easier in lane changing even the vehicle is in high speed.

B. Disadvantages

- 1) High Cost due to usage of various components.
- 2) Four Wheel Steering System is very complex so it's maintenance is difficult.

VIII. CONCLUSION

Thus, the 4WS System have steering response, cornering capability, stability in straight line, lane changing at greater speeds and smaller turning radius. 4WS System is advantageous over Conventional 2WS System, 4WS System is expensive and complex in nature. Currently the cost of 4WS System is more than 2WS System. Four Wheel steering is gains popularity in today's market and it is likely to be installed in more vehicles. When Four Wheel Steering System gets generally used in future, its price will drop down and gets available in every vehicle.

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