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PROTOTYPE OF FOUR WHEEL STEERING SYSTEM

Engineering

KEYWORDS: 4 wheel steering system, Turning Radius, Power supply Full wave rectifier

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ABSTRACT

Four wheel steering is a method developed in automobile industry for the effective turning of the vehicle and to increase the maneuverability. In a typical front wheel steering system the rear wheels do not turn in the direction of the curve and thus curb on the efficiency of the steering. In four wheel steering the rear wheels turn with the front wheels thus increasing the efficiency of the vehicle

1. INTRODUCTION

In city driving conditions the vehicle with higher track width and wheelbase face problems of turning as the space is confined, the same problem is faced in low speed cornering. The turning radius is reduced in the four wheel steering of the vehicle which is effective in confined space, in this project turning radius is reduced without changing the dimension of the vehicle.

In situations like vehicle parking, low speed cornering and driving in city conditions with heavy traffic in tight spaces, driving is very difficult due to vehicle's larger track width and wheelbase. Hence there is a requirement of a mechanism which result in less turning radius and it can be achieved by implementing four wheel steering.

2. WORKING OF EXISTING STEERING MECHANISM

The steering column is rotated by the steering wheel. At the end of this column the steering gear box is fitted. Therefore, the cross shaft in the gear box oscillates when the wheel is rotated. Drop arm is connected to the cross shaft. This is linked by means of a drag link to the steering arm. The steering arms on both wheels are connected by tie rod to the drag link. The wheels moves to the right or left when the steering wheel is operated, the knuckle moves to and fro, moving.

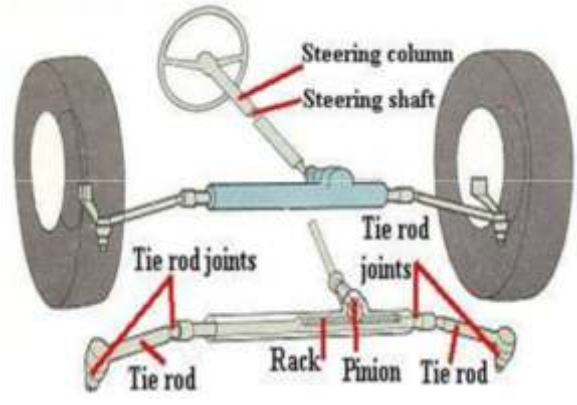


Figure 1:steering system

The ends of steering knuckle and the tie rod are connected to each other. One end of the drag link is connected to the end of drop arm and the other end is connected to the to the tie rod. A ball and socket joint gives the required movement to the joints between the tie rod, drop arm and drag link. Vibration is developed in the drop arm when the vehicle is moving. Vibration is absorbed by the Shock springs used in ball and socket system.

3. STEERING PRINCIPLES AND COMPONENTS

3.1 Ackermann steering mechanism

With perfect Ackermann, at any angle of steering, the centre point of all of the circles traced by all wheels will lie at a common point. But this may be difficult to arrange in practice with simple linkages. Hence, modern cars do not use pure Ackermann steering, partly because it ignores important dynamic and compliant effects, but the principle is sound for lowspeed maneuvers.

3.2 Steering ratio

The steering ratio is the number of degrees that the steering wheel must be turned to pivot the front wheels 1 degree. E.g.: steering ratio 18:1 implies that the front wheels will turn by 1 degree when the steering wheel turns 18 degree.

The steering ratios generally used with present day steering gears vary from about 12: 1 for cars to about 35: 1 for heavy vehicles. An average overall ratio usually gives about one and half complete turns of the steering wheel each side of mid position to apply a full lock of 45 degrees each way on the wheels.

3.3 Turning circle

The turning circle of a car is the diameter of the circle described by the outside 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 using the formula:

Turning circle radius = Track/2 + Wheel base/sin (Average steer angle)

3.4 Steering geometry

When a car is moving along a curve, all its wheels should roll truly without any lateral slip. This can be achieved if the axis of all four wheels intersects at one point. This point will be the centre about which the vehicle will be turning at that instant. Figure shows the steering geometry of the four wheels of a vehicle. The rear wheels rotate along two circles. The centres of both these circles are at O. The front wheels 1 and 2 have different axes. They rotate along two other circles with the same centre point.

3.5 Turning radius

The turning radius of a vehicle is the radius of the smallest circular turn (i.e. U-turn) that the vehicle is capable of making. The term turning radius is a technical term that has become popular automotive jargon. In the jargon sense,it is commonly used to mean the full diameter of the smallest circle, but in technical usage the turning radius still is used to denote the radius.

4. VEHICLE DYNAMICS AND STEERING

Vehicle dynamics have very importance for a balanced drive of vehicle. It can be say in three terms of steering, which are under-steer, over-steer, and neutral or counter steering.

4.1 Under-steer

Under steer is so called because when the slip angle of front wheels is greater than slip angle of rear wheels. The diagram for the under steer is given below, from the diagram the explanation is made out clear very well.

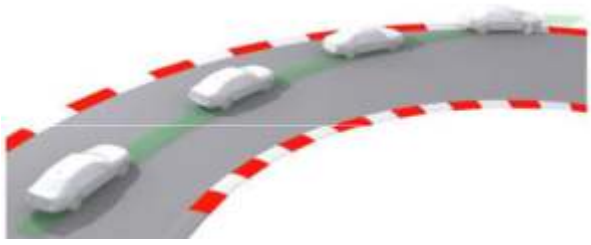


Figure 2: Under-steer [1]

4.2 Over-steer

Over steer is defined when the slip angle of front wheels lesser than the slip angle of rear wheels.

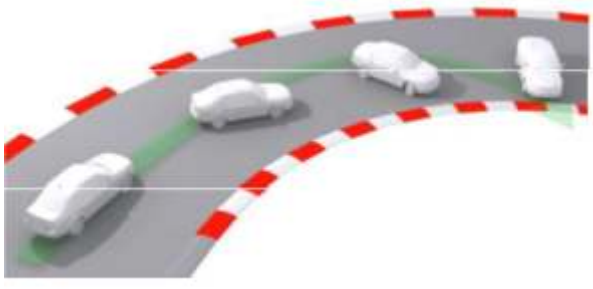


Figure 3: Over-steer [1]

4.3 Neutral-steer or Counter-steering

Counter-steering can defined as when the slip angle of front wheels is equal to slip angle of rear wheels.

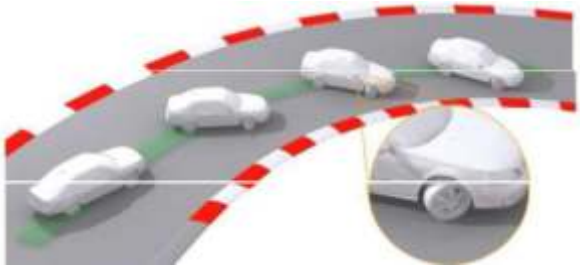


Figure 4: Neutral-steer [1]

5. WORKING OF 4 WHEEL STEERING [3]

The system is controlled from the remote control consisting of 4 Diodes – 4007 diodes, Slide switch – to control the forward and backward movement of the wheels, micro switch – to control the left and right movement of the wheels, capacitor of 3700 microF which stores the extra energy and transformer which gives an AC of 24 volt by using the full wave rectifier power supply circuit. Bridge circuit is used of the diodes to convert the AC coming from the transformer into the Full wave DC.

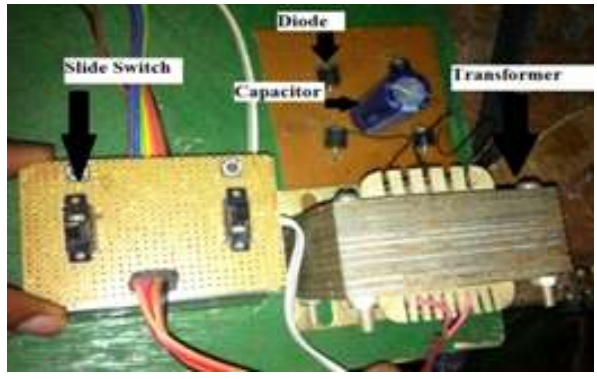
Wiper motor transfers the power to the spur gears system which moves the tyres with the help of the rod connected through. Gear motor fixed to the four tyres each help in moving the tyres left and right. The system runs on a speed of 20- 40 kph.

Each tyres rotate on its own axis helping to rotate the whole system to move in the 360 degree.

6. COMPONENTS OF SYSTEM

6.1 Remote control elements

a) 4 Diodes – 4007 diodes.
b) Slide switch – To control the forward and backward movement.
c) Micro switch – To control the left and right movement.
d) Capacitor – 3700 microF.
e) Transformer – Gives an AC of 24 volt.



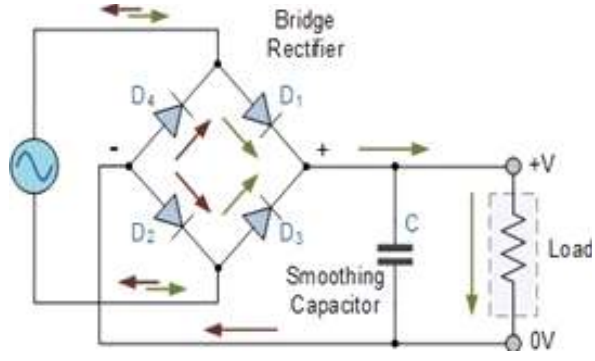


Figure 5: Circuit used- Power supply Full wave rectifier.

6.2 SPUR GEARS

a) 7 gears are used.
b) Made of Cast iron
c) Has 42 teeth
d) Diameter 3 inch
e) After gaining the power from wiper motor this system transferit to the tyres.

Figure 6: Spur gear arrangement

6.3 Chassis

a) Holds the whole system of gears to make the motion possible.
b) Dimensions of chassis = 27 inch X 11 inch.
c) Material cast iron.
d) Metal arc welding is used.
e) Hacksaw is used for cutting the rod to its dimensions.
f) Grinder is used for smoothening the rod after welding.

Figure 8: Dimensions of chassis

6.4 Wiper Motor

a) Runs on direct current.
b) Helps in forward and backward motion of the wheels.
c) Power comes in form of direct current which turns the gear chain to travel it to and fro.
d) Specifications
   30 – 50 rpm
   2 to 24 volt
   2-5 Ampere current

Figure 11: Wipe motor

6.5 Gear Motors

a) Helps in turning Left and right.
b) Runs on the direct current.
c) Specifications
   6 – 12 volt
   500 milli Ampere – 1 Ampere
   50 – 100 rpm

Figure 12: Gear motor

6.6 Supporting Wheels

a) Diameter of tyres = 4.5 inch
b) The wheels are on which the whole system moves.

Figure 13: Supporting Wheels

7. Experiment Results

Turning radius	Four wheel steer
By calculating	1.295
By experiment	1.425

Table 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%.

8. ADVANTAGES

a) Each tyre moves on its own axis.
b) The Whole prototype can be moved in the 360 degree direction on its own position.
c) All tyres moves in the same direction.
d) Direct power is supplied to each gear motor to control the motion.

9. DRAWBACK

The system is not stable at high speed gets overpowered and may topple in some cases.

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