

Fabrication of 360 Degrees Rotating Vehicle for a Four Wheel Steering System of a Car

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Abstract- Modern development and economical progression of Indian society resulted in increase of cars on roads. Due to space constraints, car parking is the major problem faced in most parts of the country. Present study aims for development of a system to reduce the turning radius of a car. The indigenously developed system consists of Ackerman steering and various mechanism with arrangement of the various kinematics links. In this system at first vehicle is stopped and wheels are then turned in the required direction with the help of steering system. It has turning radius nearly equal to negligible of the length of car itself. This system can be useful in better parking, traffic jam, back turning on narrow roads, etc.

Keywords: *space constraints, car parking, turning Radius, Kinematic Links, Steering System, traffic jam*

1.INTRODUCTION

A Four Wheel steering (4WS) System is also known as "Quadra Steering System". In this Paper, both front as well as rear wheels can be steered according to speed of the vehicle and Space available for turning. Quadra Steering system works in following three phases Negative phase, Neutral phase, Positive phase. It enables the car to be steered into tighter parking spaces. It makes the car more stable at Speed (less body roll). It makes the car more efficient and stable on cornering, easier and safer Lanes change when on motorways. The main aim is that turning of the vehicle should not require greater efforts on the part of the driver. The Quadra steer steering system offers a 21% reduction in turning radius. So if a vehicle is capable of making a U-turn in a 25-foot space, Quadra steer allows the driver to do it in about 20 feet.

With increase in number of vehicle people have to face traffic problems like parking, taking reverse etc. So here we have "FABRICATION OF 360 DEGREE ROTATING CAR" for these above mentioned purposes. These problems can be efficiently reduce and eliminated by the use of this application we use.

This difficulty that is associated with the conventional methods of steering is eliminated by employing a four wheel steering system. In this system, the wheels connected to the front axles are turned opposite to each other, and so are the

Wheels connected to the rear axle. The wheels on the one left half vehicle rotate in one direction and the ones on the right half of the vehicle rotate in the opposite direction. This arrangement of the wheels enables the vehicle to turn 360 degrees, without moving from the spot, i.e. the vehicle has zero turning radiuses. This helps in man everything the vehicle in tight spaces such as parking lots and within small compounds.

Also in situations like low speed cornering, vehicle parking and driving in city conditions with heavy traffic in tight spaces, driving would be very difficult due to vehicle's larger wheelbase and track width.

2.LITERATURE REVIEW

Vijayan.m.g, Shahroz Alamp [1] Four Wheel Steering System The four wheel steering control with rear wheel drive is a new concept which can be implemented in four wheeler vehicles. Four-wheel steering is a system can employed in some vehicles to improve steering response, increase vehicle stability while moving at certain speed, or to decrease turning radius at low speed. In four-wheel steering systems, the rear wheels are control by a gear arrangement. This allows the vehicle to turn in a significantly smaller radius sometimes critical for large trucks or tractors and vehicles with trailers.

B. L. Salvi [2] Developing a System for Reducing the Turning Radius of a Car This paper aims for development of a system to reduce the turning radius of a car. The indigenously developed system consists of screw jack, gears and mechanism with arrangement of the various kinematics links. The developed system was electric motor driven. In this system at first car is lifted and then turned in the required direction. The mechanism was found sufficiently capable in turning the car in any direction without steering and has turning radius equal to the half of the length of car itself. The car can be turned back in 40 second. This system can be useful in better parking, traffic jam, back turning on narrow roads, changing of punctured wheels etc.

Er. Amitesh Kumar [3] Zero Turn Four Wheel Steering System Conventional steering mechanism involves either the use of Ackerman or Davis steering systems. The disadvantage associated with these systems is the minimum turning radius that is possible for the steering action. This difficulty that is associated with the conventional methods of steering is eliminated by employing a four wheel steering system. In this system, the wheels connected to the front axles are turned opposite to each other, and so are the wheels connected to the rear axle. The wheels on the on left half vehicle rotate in one direction and the ones on the right half of the vehicle rotate in the opposite direction. This arrangement of the wheels enables the vehicle to turn 360 degrees, without moving from the spot, i.e. the vehicle has zero turning radius. This helps in maneuvering the vehicle in tight spaces such as parking lots and within small compounds

3. TYPES OF GEARS

Spur Gear, Helical Gear, Herringbone Gear, Bevel Gear, Worm Gear, Rack and Pinion, Internal and External Gear, Face Gear, Sprockets

(a) **Spur Gear**-Parallel and co-planer shafts connected by gears are called spur gears. The arrangement is called spur gearing. Spur gears have straight teeth and are parallel to the axis of the wheel. Spur gears are the most common type of gears. The advantages of spur gears are their simplicity in design, economy of manufacture and maintenance, and absence of end thrust. They impose only radial loads on the bearing. Spur gears are known as slow speed gears. If noise is not a serious design problem, spur gears can be used at almost any speed.



Fig. 1: Spur Gear

(b) **bicycle Chains** : A bicycle chain is a roller chain that transfers power from the pedals to the drive-wheel of a bicycle, thus propelling it. Most bicycle chains are made from plain carbon or alloy steel, but some are nickel-plated to prevent rust, or simply for aesthetics.

(c) **Maintenance**: A city bicycle's chain protected by a chain case. How best to lubricate a bicycle chain is a commonly debated question among cyclists. Liquid lubricants penetrate to the inside of the links and are not easily displaced, but quickly attract dirt. "Dry" lubricants, often containing wax or Teflon, are transported by an evaporating solvent, and stay cleaner in use. The cardinal rule for long chain life is never to lubricate a dirty chain, as this washes abrasive particles into the rollers. Chains should be cleaned before lubrication. The chain should be wiped dry after the lubricant has had enough time to penetrate the links. An alternative approach is to change the (relatively cheap) chain very frequently; then proper care is less important. Some utility bicycles have fully enclosing chain guards, which virtually eliminate chain wear and maintenance. On recumbent bicycles the chain is often run through tubes to prevent it from picking up dirt, and to keep the cyclist's leg free from oil and dirt.



Fig 2: Oil Can

The consideration in chain is Removal, Wear, Sizes, Width, Length, Vibrations

(d) Type of chains

- Roller chains
- Conveyor chains
- Special chains
- Agriculture chains

(e) Types of raw materials used

- Job flat
- Tube material
- Pin material

(f) Types of Wheels

Attachment of Rim, tube, tubeless, studs, rim width and pressure are the consideration in the wheel

4. WORKING PRINCIPLE

(a) **Steering Mechanism**: The steering mechanism consists of rack and pinion arrangements which are used to turn the wheels in the front. And a bevel gear arrangement is made just after the steering and power is transmitted through the transfer shaft to the gear box assembly. Then power is transmitted to the rear wheels.

(b) Ackermann Steering Gear Mechanism:

Ackermann steering geometry is a geometric arrangement of linkages in the steering of a car or other vehicle designed to solve the problem of wheels on the inside and outside of a turn needing to trace out circles of different radii. The steering pivot points are joined by a rigid bar called the tie rod which is also a part of the steering mechanism.

With perfect Ackermann, at any angle of steering, the center point of all of the circles traced by all wheels will lie at a common point. Modern cars do not use pure Ackermann steering, partly because it ignores important dynamic and compliant effects, but the principle is sound for low speed maneuvers, and the right and left wheels do not turn by the same angle, be it any cornering speed.

We chose to use a simple control circuit to demonstrate the effectiveness of a four wheel steering system, and at the same time, simulated the suspension-steering assembly of a typical car to predict the Ackerman angles for corresponding steer angles. The design calculation for the model follows shortly.

The Ackerman steering gear consists of turning pairs rather than sliding pairs. The whole of the mechanism is placed on the back of the front wheels.

In Ackerman steering gear, the mechanism ABCD is a four bar crank chain. The shorter links BC and AD are equally inclined to the longitudinal axis of the vehicle. For the correct steering the following three positions are obtained.

- When the vehicle moves along a straight path, the longer links AB and CD are parallel and the shorter links BC and AD are equally inclined to the longitudinal axis of the vehicle.
- When the vehicle is moving to the left, the lines of the front wheel axle intersect on the back wheel axle at I for correct steering.

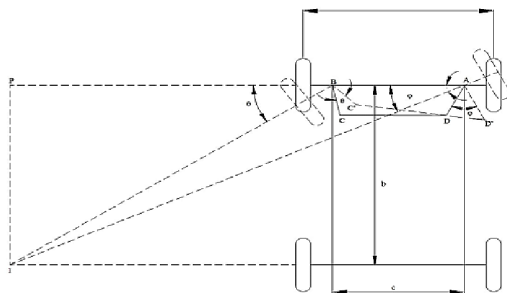


Fig 3: Ackerman Steering Mechanism

(C) Davis steering gear mechanism

The slotted links AM and BH are attached to the front wheel axle, which turn on pivots A and B respectively. The rod CD is constrained to move in the direction of its length, by the sliding members at P and Q. These constraints are connected to the slotted link AM and BH by a sliding and a turning pair at each end. The steering is affected by moving CD to the right or left of its nominal position.

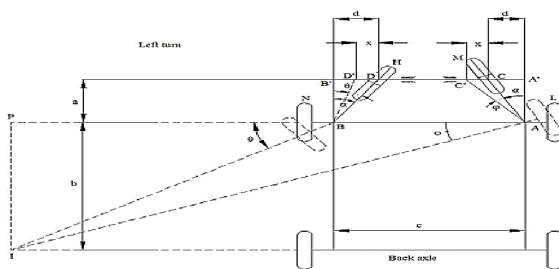


Fig 4: Davis Steering Mechanism

Some steering mechanisms are Bell crank steering linkage, Rack and Pinion linkage, Toe in & Toe Out, under steer, over steer, Neutral steer or counter steering

5. EXPERIMENTAL WORK



Fig 5: The arrangement of steering wheel with gears



Fig 6: Gear design & with chain final setup

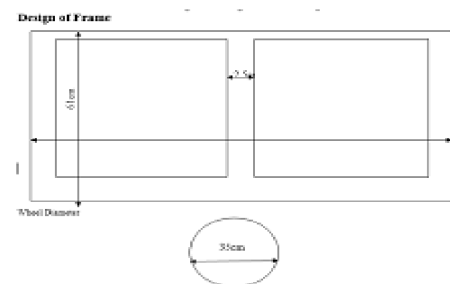


Fig 7: Design of Frame & Tire Diameter

(a) Specifications

- Total no of wheels = 4
- Total no Spur Gears = 4
- Total no of bushes = 4
- Total no of U clamps = 4
- Total no of teeth for all Gears = 17
- Height from the base to frame = 50 cm
- Height from the base to handle = 80cm
- Total length of the chain = 310cm
- One complete revolution of the vehicle – 131cm

(b) Formulas

- Turning circle radius for the inner front wheel
 $RIF = (b/\sin \delta_i) + (a-c/2)$
- Turning circle radius for the outer front wheel
 $ROF = (b/\sin \delta_o) + (a-c/2)$
- Turning circle radius for the inner rear wheel
 $RIR = (b/\tan \delta_i) + (a-c/2)$
- Turning circle radius for the outer rear wheel
 $ROF = (b/\sin \delta_o) + (a-c/2)$



Fig 8: Operating Panel

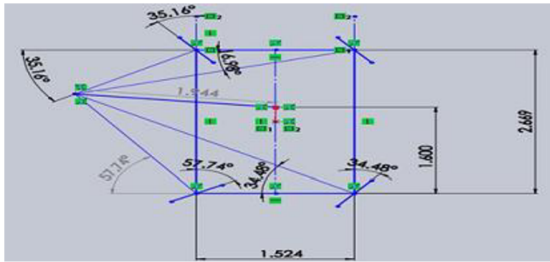


Fig 9: Dimensions for the wheel vehicle



Fig 10: Parking in less space



Fig 11: Side view of the wheels when in turn

6. CONCLUSION

Thus the four-wheel steering system has got cornering capability, steering response, straight-line stability, lane changing and low-speed maneuverability. Even though it is advantageous over the conventional two-wheel steering system, 4WS is complex and expensive. Currently the cost of a vehicle with four wheel steering is more than that for a vehicle with the conventional two wheel steering. Four wheel steering is growing in popularity and it is likely to come in more and more new vehicles. As the systems become more commonplace the cost of four wheel steering will drop.

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- Even though it is advantageous over the conventional two-wheel steering system, 4WS is complex and expensive. Currently the cost of a vehicle with four wheel steering is more than that for a vehicle with the conventional two wheel steering.
- Four wheel steering is growing in popularity and it is likely to come in more and more new vehicles. As the system has multi-utility it will be very much useful in industrial areas. The system can replace conventional scrap collecting systems.

An innovative feature of this steering linkage design and its ability to drive all four (or two) wheels using a single steering actuator. Its successful implementation will allow for the development of a four-wheel, steered power base with maximum maneuverability, uncompromised static stability, front- and rear-wheel tracking, and optimum obstacle climbing capability.

Automobile industry is very fast growing industry and day-by-days developing the new technologies/systems that are mainly related to safety, ergonomics and efficient drive.

The developed model was tested in various conditions and effectively reduced the turning radius to its minimum in the developed model. The reduced turning circle diameter (nearly about zero) has lots of advantages in daily life, such as-

- Better parking at home in narrow space and at multiplexes
- Easy removal of vehicle from the traffic jams
- Easy changing the punctured tyre,
- Turning back at narrow roads
- Use in service and maintenance etc.

The system can be developed using the hydraulic system. This can give fast response and less space is required. The developed model is recommended for inclusion in the cars. By the analytical and experimental analysis and results we conclude that;

- Four wheel steering concept was generated
- The four wheel concept was simulated in ADAMS to check for functionality of Mechanism

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