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Four Wheel Steering System for Automobiles

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Abstract: Work is based on the steering system modification that a new type of steering mechanism can be employed over conventional steering system. This includes steering over all of the 4 wheels instead of 2 wheels as in the present world. This has led to greater comfort for the driver to drive the vehicle whether it comes to taking a turn or it comes to changing lane over the highway. There are three modes for its operation which can be employed as per the requirement.

I. INTRODUCTION

The Steering means to guide the vehicle to move in a particular direction with the help of a mechanism. For this application a steering wheel is used which is used to turn the vehicle. The most conventionally used steering system is to turn the front wheels of the vehicle to take a desired turn, in this axis of rear wheel remains fixed in regard to the vehicles chassis. The fundamental condition for correct steering is then the instantaneous center of the front wheels and the rear wheels must coincide to avoid skidding otherwise there will be a problem of skidding and tyre will have more wear and tear. There are 2 mechanisms generally employed in vehicles to take a turn these are

A. Ackerman Steering Gear Mechanism

This mechanism is used generally in all automobiles. This is widely accepted just because of its simplicity and the types of pairs it uses. This mechanism uses turning pairs and provides condition for correct steering. It consists of 4 links having 4 turning pairs represented by A, B, C, D. The whole mechanism is on the back side of the front wheels as shown in figure 1:

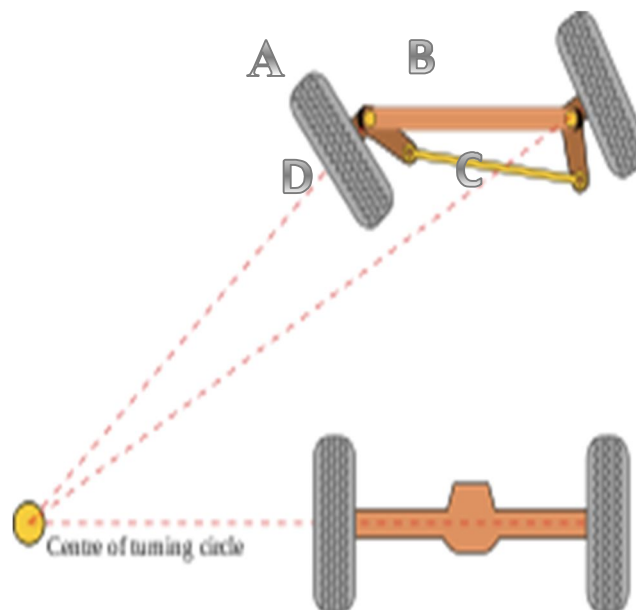
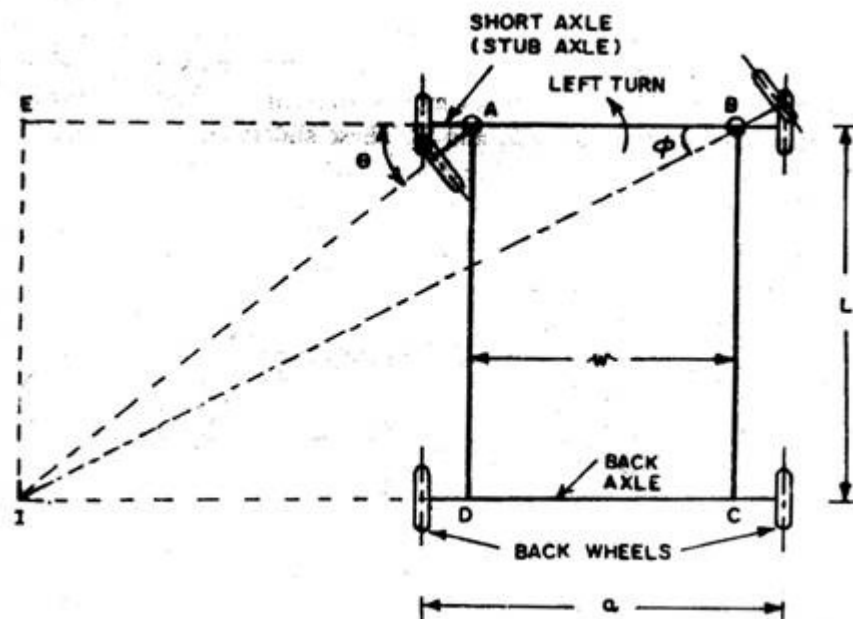


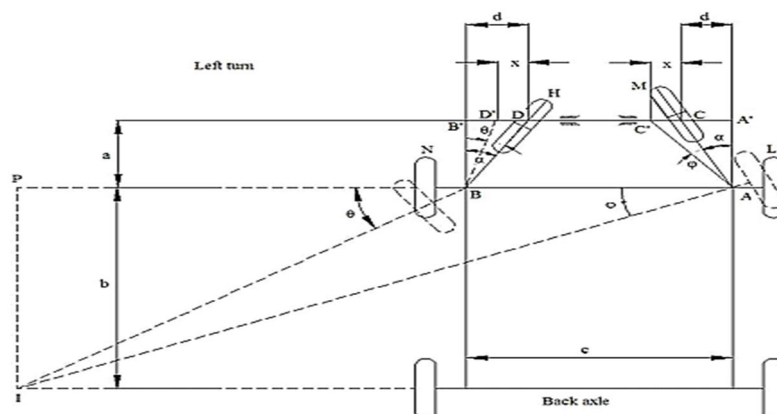
Figure 1: Ackerman Steering Gear Mechanism

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So fundamental condition for correct steering is $\cot \theta - \cot \phi = \frac{a}{L}$

B. Davis Steering Gear Mechanism



Davis steering gear mechanism uses sliding pairs. There are 4 sliding pairs that are used in the steering mechanism. These sliding pairs fails very soon also for each position both θ and ϕ are different so more wear and tear is there so this steering mechanism is not widely used.

The concept of 4 wheel steering uses control over all the 4 wheels instead of conventional front wheels which is used today. It involves turning both the front and rear wheels according to our requirement.

II. GEARING MECHANISM

All the mechanism for turning of wheels over the road to turn in a desired direction involves some mechanism. Gearing mechanism is used in this arrangement which converts rotary motion of steering wheel to translational motion of the wheels of vehicle. There are multiple gears available for this operation

A. Rack And Pinion

A rack can be thought of as a gear of infinite radius and a pinion can be considered as a gear of very small radius so when a pinion meshes with a rack its rotary motion can be converted into translational motion with this arrangement. This mechanism with rack

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and pinion arrangement is used in vehicles to convert the rotation of the steering wheel into the left or right motion of the tie rod according to direction of rotation of steering wheel.

B. Bevel Gear

Bevel gears are gears in which the axes of two shafts intersect with each other. These gears are generally conically shaped. Generally bevel gears are mounted on shafts which are at 90 degrees to each other but they can be designed to work at other angles also. These are further divided as

- 1) *Straight Bevel Gear*: Gears with straight contours are straight bevel gears. These gears can operate at high speed and for a high load. Straight bevel gear is shown in figure below:



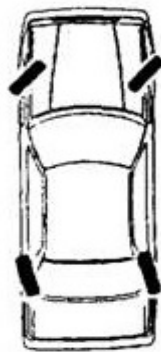
- 2) *Spiral Bevel Gear*: These gears have larger contact ratio as these are spiral also their operation is much smoother and they have large load carrying capacity.

III. FOUR WHEEL STEERING SYSTEM

Four wheel steering system also known as Quadra Steering System controls all the 4 wheels while turning there are multiple components which are required for this steering system design. These are Rack and Pinion, Bevel Gears, Steering, Wheel, Hinge Joint, Spur Gear. This four wheel steering system operates in three modes which are

A. Negative Mode

In this mode both the front and the rear wheels of the vehicle move in opposite direction with respect to each other. This type of mode is useful for slow driving case and a steep curve or during parking of the vehicle as this requires very less space for turning of the vehicle as compared to other modes. This mode is very much beneficial where traffic is a big problem.



B. Neutral Mode

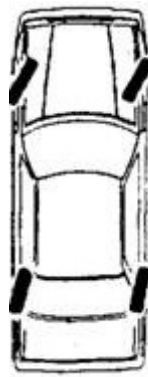
In this mode only the front wheels are steered and the rear wheels remain straight. This mode is simply the conventional steering mechanism.

C. Positive Mode

In this mode the front and rear wheels rotate in the same direction. This mode is very much beneficial for the lane changing during

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driving at comparatively higher speeds.



All these 3 modes can be brought in action as per our requirement. For this a lock nut can be provided in the main arrangement which will engage and disengage the positive mode or negative mode as and when required. When the lock nut is removed from the main arrangement the steering operation is carried out in normal conditions. In this normal condition only front wheels will steer. When the lock nut is inserted into the engaging mechanism the other two modes can be used. When the locking nut is pushed to one position, the attached gears get engaged and the steering of rear wheel is provided in same direction as that of the front wheels. When the locking nut is pushed to other side secondary gears get engaged and the rear wheel steers in opposite direction to the front wheel. This results in negative mode steering.

IV. COMPARISON

Four wheel steering system has led to following benefits over the two wheel steering system:

- A. Four wheel steering system can be employed to work as a two steering gear mechanism also so all the benefits of two wheel steering are absorbed in the four wheel steering system.
- B. With the use of 4 wheel steering system vehicle becomes more efficient and stable while on corners.
- C. Stability of 4 wheel steering system is more for straight line motion.
- D. 4 wheel steering system provides smaller turning radius as compared to 2 wheel steering system.
- E. This has led to greater reduction in driver efforts for turning a bigger vehicle.

V. CONCLUSION

The four wheel steering system is very much beneficial over the front or rear wheel steering system as it greatly decreases the efforts required for turning of vehicle and also provides steep turning option within a very confined space.

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