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A Review on Design and Assembly of Go- Kart Steering System

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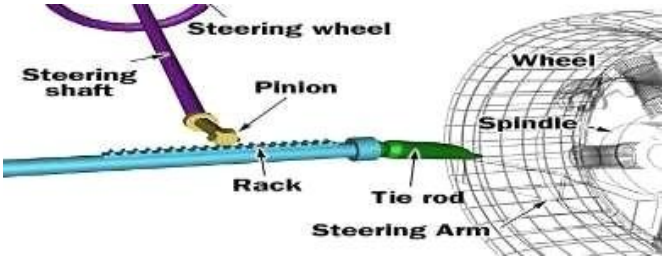
***Abstract*—**Aim of project is to perform design optimization of steering column to nullify its functions-ability related with stresses deformation, vibrations also minimize cost by saving material to compare original model. The main Realistic approach of geometry selection for steering mechanism is followed by designing with the help of Solid Works 2017&The steering ratio turning radius, steering efforts, front wheels turning angles are optimized. The goal of designing and optimizing the steering mechanism is to provide good directional stability and full control over the vehicle even on the sharp turns. Objective of this paper is to give detailed review of vehicles steering mechanism

***Index Terms*— Go-Kart, Steering System, Rack and Pinion, Ackerman Steering Mechanism, Design, Analysis.**

1. INTRODUCTION

The steering system of car is not only impotant for safety reasons but also the enhance the comfort of car's ride. The objective of this project is to design a steering rod which has same working capabilities as existing one by saving the material and find out vibration effects and behavior of rod at harmonic frequencies in an automotive steering system

This objective is worth pursuing because the issue of stresses developed in an object, design requirement at the joints, deformation in body due to vibrations, continuous twisting and loading these are the common one related to steering rod and is a real problem in the modern automotive industry Two main types of steering system are used on modern cars and light trucks: the rack-and pinion system and the conventional or parallelogram linkage, steering system. On automobiles, the conventional system was the only type used until1970.it has been almost replaced by rack-and pinion steering.



Above fig. shows the Rack and pinion steering is a simple system that directly converts the rotation of the steering wheel to straight line movement at the wheels.

2. REQUIREMENTS OF STEERING SYSTEM

Steering system is primarily used to achieve the angular motion of the front wheels of a vehicle to negotiate a turn. This is done through linkage and steering gear which convert the rotary motion of the steering wheel into angular motion of the front wheels.

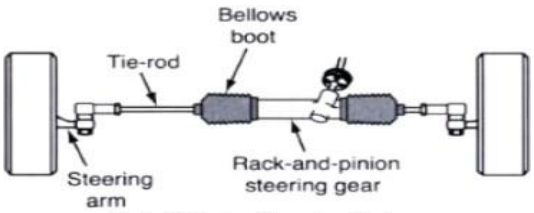
The requirements of a good steering system are:

1. The steering mechanism should be very accurate and easy to handle.

2. The effort required to steer should be minimal and must not be tiresome to the driver.

3. STEERING SYSTEM USED

The steering mechanism should also provide directional stability. This implies that the vehicle should have a tendency to return to its st Rack and Pinion Steering System:



Rack & Pinion Steering System

Figure shows the rack and pinion steering system.

1.The rack and pinion steering system is simpler, lighter, and generally cheaper than worm-type systems.

2.The steering column rotates a pinion gear that is meshed to a rack.

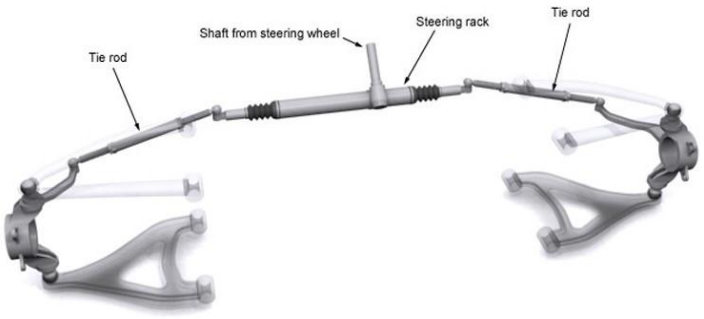
3.The rack converts the rotary motion directly to side-to-side motion and is connected to the tie rods.

4.The tie rods cause the wheels to pivot about the kingpins, thus turning the front wheels.

5.Rack and pinion systems have the advantage of providing feedback to the driver.

6.Furthermore, rack and pinion systems tend to be more responsive to driver input, and for this reason, rack and pinion steering is found on most small and sports cars. Right ahead position after turning.

The steering system consists many modern cars use rack and pinion steering mechanisms, where the steering wheel turns the pinion gear; the pinion moves the rack, which is a linear gear that meshes with the pinion, converting circular motion into linear. Older designs often use the recirculating ball mechanism, which is still found on trucks and utility vehicles. The recirculating ball mechanism has the advantage of a much greater mechanical advantage, so that it was found on larger, heavier vehicles while the rack and pinion was originally limited to smaller and lighter ones. To achieve the correct steering, two types of mechanisms are used. They are the Davis & Ackermann 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 radius. A simple approximation to perfect Ackermann steering geometry may be generated by moving the steering pivot points inward so as to lie on a line drawn between the steering kingpins and the center of the rear axle. The steering pivot points are joined by a rigid bar called the tie rod which can also be part of the steering mechanism, in the form of a rack and pinion for instance. 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. Note that this may be difficult to arrange in practice with simple linkages, and designers are advised to draw or analyze their steering systems over the full range of steering angles. Front wheel alignment (also known as front-end geometry) is the position of the front wheels relative to each other and to the vehicle. Correct alignment must be maintained to provide safe, accurate steering, vehicle stability and minimum tire wear. The factors that determine wheel alignment are interdependent. Therefore, when one of the factors is adjusted, the others must be adjusted to:-



4. RACK AND PINION STEERING SYSTEM

A. The steering system consists

1. Steering wheel

2. Steering shaft

3. Steering shaft joints

4. Steering pinion

5. Steering rack

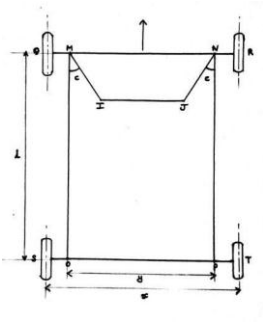
6. Steering gear case

7. Tie rod

8. Steering knuckle

This mechanism is simple and driver-friendly. It is the most effective and hence; widely used steering system by car manufacturers around the world. It is universally accepted that it is the best system to use. The mechanism consists of a pinion at the end of the steering Coolum that meshes with the rack. The pinion is fixed to the steering column at its end. It meshes with the rack which moves either to the left or the right side depending upon the movement of the pinion. The main purpose to use Ackerman is to avoid skidding of front tyres while turning. It is undesirable if the tyre drags while turning. Ackerman geometry helps in avoiding the skidding. It turns the front tyres optimally by allowing both tyres to turn by different angles. That is, inner tyre by greater angle

as Compared to outer angle. The geometry in which, inner angle turns by greater extent as compared to outer tyre is termed as Ackerman geometry. Basically, Ackerman geometry comprises of a trapezoid. The idea behind Ackerman is to draw lines from each of the steering arms such that they meet at centre of the rear axis. That, is the steering arms are inclined by such an angle that when we draw lines from each of the steering arm towards rear axis, they will meet at the centre of the rear axis. This condition where rack position is behind the front axis is called Ackerman condition.



When the vehicle turns, the outer tyre has to turn less than the inner tyre to avoid drag and give good feeling to the driver while cornering at high speed. While turning, the geometry looks like the figure mentioned b

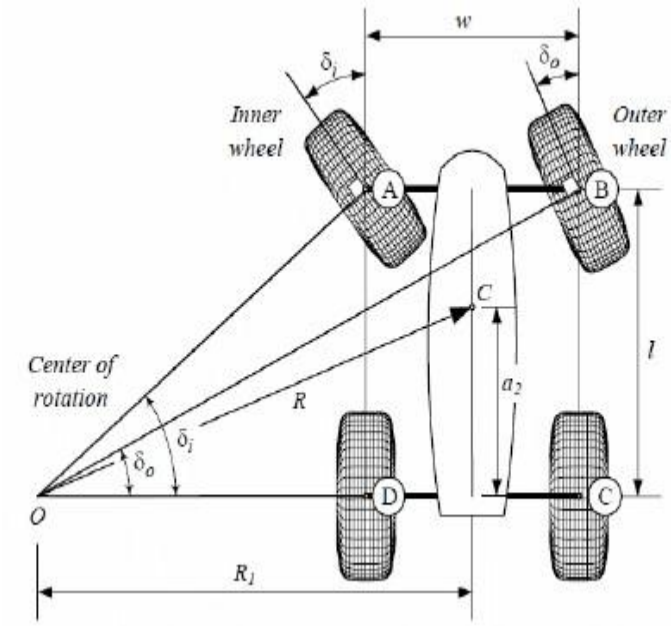


Figure.b

5. ACKERMANN STEERING MECHANISM

Understeer and oversteer are vehicle dynamics terms used to describe the sensitivity of a vehicle to steering. Oversteer is what occurs when a car turns (steers) by more than the amount commanded by the driver. Conversely, understeer is what occurs when a car steers less than the amount commanded by the driver. Automotive engineers define understeer and oversteer based on changes in steering angle associated with changes in lateral acceleration over a sequence of steady-state circular turning tests. Car and motorsport enthusiasts often use the terminology more generally in magazines and blogs to describe vehicle response to steering in a variety of maneuvers. In America, especially in NASCAR, Understeer is called 'tight', and Oversteer is called 'loose.[1]

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.

It was invented by the German carriage builder Georg Lankensperger in Munich in 1817, then patented by his agent in England, Rudolph Ackermann (1764–1834) in 1818 for horse-drawn carriages. Erasmus Darwin may have a prior claim as the inventor dating from 1758.[1] Darwin devised the steering system because he was injured when a carriage tipped over.

Consideration in Steering Mechanism

1. Wheel Base
2. Ackermann Angle
3. Inner steer angle
4. Outer steer angle
5. King pin angle
6. Caster angle
7. Camber angle
8. Steering ratio
9. Steering effort
10. Steering wheel lock angle
11. Minimum turning radius
12. Maximum turning radius

13. Toe in

14. Scrub radius[3]

Assumptions

1. 100% Ackermann steering geometry.

2. Maximum road bank angle is 20 degree.

3. 4 to 8 degree optimum king pin inclination angle.

4.42:58 or 40:60 front to rear weight ratio.

5. Taking 10m/s^2 as acceleration due to gravity [3] [5].

6. Steering ratio is considered approximately 1:1 for Go-kart.

6. ANALYSIS OF THE STEERING SYSTEM COMPONENTS

- In order to determine factor of safety for some components external factor which is applied on the components such as loads temperature pressure etc are applied on the components for analyzing the components to obtain various appropriated or approximate values of different types of stresses acting on the component such as (bending, tangential and normal), for deformation on the components after applied of external factor in practical used. To understand stresses acting on the components based on various factor it gives optimum result of the safety of components. This analysis gives the appropriated or approximate result and safety of the components and chances of failure is eliminated. Various computer software packages are available in the market to carry out different types of analysis under various loading conditions. Such as ANSYS, SOLID WORKS, HYPERWORKS and FLOTRAN etc. this are the various software for analysis of components.
- Two Major Analysis Carried Out
    - Deformation analysis system
    - Stress analysis
- Various Components Analyze
    - Steering gear
    - Steering rack
    - Steering pinion
    - Intermediate steering shaft
- Analysis Performing Process
- Importing the geometry to software interface(GUI)
- Defining the area
- Material properties are applied
- Appropriate element size meshing the components
- Applying external factor such as load, pressure, temperature on the components body
- Boundary condition is applied such as fixed support(Constraints)
- Solver is used for solving the problems
- The required action or values of stress acting on hot components is obtained and deformation of the body member under certain loads.

7. CONCLUSION

In this review paper, the best to the knowledge basics with design and assembly of the go-kart steering system is gathered with the help of the researchers and their documentations, the purpose of the steering system their requirements, the design methodology, the overview of the steering system used in the go-karts, the steering system current used rack and pinion their components to be consider, working of the system. The steering mechanism used which is Ackermann steering geometry is discussed with the steer cases and is explained in simple quadrilateral notation form with terms considered in mechanism and the assumptions made during the solution of the Ackermann steering geometry problems. The analysis of the steering system components through various software's can be performed which determines the stresses, loads and deformation of the steering system from which the design engineers can predict the safety of the system and can also be modified and minimization of the errors in the systems can be done, this is the knowledge and data about the design, assembly and analysis without any mathematical considerations.

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