Design and Manufacturing of Steering System in an Off Road Buggy: A Review

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ABSTRACT

In order to turn the vehicle, steering mechanism is required. Nowadays most of the four-wheelers are having steering mechanism based on Ackerman principle. In order to design steering mechanism based on Ackerman principle, one method is to use rack and pinion with tie rods. In the present work, new mathematical model is developed in order to design steering geometry mentioned above considering different geometry parameters. This mathematical model includes three equations. By solving this three equations we can get different steering geometry parameters by fixing some variables according to restriction and considering optimum steering geometry with respect to steering effort and %ackerman. This model can be used for ackerman as well as reverse ackerman steering geometry and further it can be used for two wheel steering as well as four wheel steering by applying this model on front and rear steering design.

Keywords—Ackerman Principle, Steering Geometry, Rack and Pinion, Mathematical Model, Design, Manufacturing.

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I. INTRODUCTION

The design of steering system has influence on the directional response behaviour of a motor vehicle that is not fully appreciated. The function of steering is to steer front wheel with respect to driver command input in order to provide overall directional control of the vehicle. The steering system plays an important role for the vehicle as it is the "interface" between the driver and the vehicle. The driver turns the steering wheel which will rotate the steering column and give further movement in the steering rack. The motion is then transmitted to the wheels by the tie rods. The design and type of the steering rack depends on the system chosen. The steering systems used are divided into power assisted and manual steering systems, each designed to help the driver to turn easily for optimal performance with different configuration of the vehicle. Since the steering system is directly operated by the driver it is essential to take human comfort into consideration while designing the steering. The effort required by the driver in handling the steering is an important factor.

The steering wheel connects by shaft, universal joint and vibration isolator to steering gear box whose purpose is to transform rotary motion of steering wheel to translating motion appropriate to steer wheels. The Rack and Pinion system consist of a linearly moving rack and pinion, mounted on firewall or forward cross member, which steers the left and right wheel directly by a tie rod connection. The tie rod connection linking with wheels by steering arm, thereby controlling the steer angle with the tie rod located ahead of the wheel corner.

REVIEW OF WORK CARRIED OUT:

Dipalkumar Koladia *et al*. studied that Mathematical Model to Design Rack And Pinion Ackerman Steering Geometry', in journal he studied By applying and solving

three equations of mathematical model for any vehicle, rack and pinion Ackerman steering geometry for any vehicle can be designed. Steering geometry can be optimized by using mathematical model for Ackerman condition for different inner wheel angles and select geometry for which percentage Ackermann as well steering effort is optimum. This mathematical model can be applied to rear wheel steering also. To design four wheel steering in which rack and pinion geometry is at front as well as rear side, this mathematical model should be applied on front and rear side separately.

M. Sohail Parvez, Imran J. Shaikh and M. Shakebuddin *et.al.*,'A Literature Review on Collapsible Steering Column', AHFE he studied In this paper, a case study is performed on an existing steering column of passenger car. This is a rigid column which under crash situation transfers the energy directly to the driver. Thus causing several injury or even fatalities. So, I am modifying this design from a rigid steering to a collapsible steering column Therefore a safer steering column design called collapsible steering column is design by replacing unsafe single-piece steering column i.e. rigid steering column. The safely enhanced construction of the collapsible steering column, no matter which design is used, absorbs, rather than transfers, frontal impact energy by collapsing or breaking upon impact. In this way, drivers involved in frontal impact collisions are able to avoid the dangers of non-collapsible steering parts.

Utkarsh. M. Desai and Dhaval A. Patel *et al*.,"Static and Dynamic Analysis of Composite Material for Spur Gear" , in this paper he studied that, The weight of GF 30 PEEK Composite Material is reduced as compared to the existing Material (Alloy steel) which in turn results in improved power transmission which overall improves the efficiency of the system. Besides, from the cost aspects, initially, composite material GF30 PEEK is costly than alloy steel material. However the characteristics of composite GF 30 PEEK material such as weight reduction of the component by 70% without losing strength, better corrosion strength, wear, fatigue. Finite element modal for spur gear is formulated to study the free vibration behaviour for both material. From the analysis it is observed that the natural frequency obtained from the mathematical analysis is good agreement with the results of finite element modal analysis.

Rince Wins, Dhanesh Chatta and Anish Nair *et al*., "Design of Pneumatic Collapsible Steering" in this paper, he studied that, as we know, the fact is very correct that accidents are increasing day by day. On considering the injury potential of steering wheel this project gives a new and more safer design for the steering wheel. We hope this project will be a helping hand to decrease the death rate due to frontal collision. Pneumatic collapsible steering production cost is low. It can get more comfort by increasing the pressure of gas or air in it. It is sensitive since it work with sensors during collision. Steering column provides good safety device against collision. Its maintenance cost is low since need only to replace air or gas in it. The main advantages of pneumatic steering are that provides working space for proper functioning of air bag.

M. Keerti, K. Sandhya, K.Srinivas *et al*., "Static & Dynamic Analysis of Spur Gear using Different Materials" in this paper, he studied that, composite materials is approximately same as compared to the structural steel, grey cast iron and aluminium alloy. So from these analysis results, we conclude that, the stress induced, deformation and weight of the composite spur gear is almost same as compared to the structural steel spur gear, grey cast iron spur gear and aluminium alloy spur gear. So, Composite materials are capable of using in automobile vehicle gear boxes instead of existing cast steel gears with better results. The design is safe since the frequencies obtained exceeded the natural frequency of the spur gear.

A. Thirugnanam, Praphul das and Lenin Rakesh *et al*. [6] "Design and Fabrication of Rack and Pinion Lift" in this paper he studied that lifting mechanism. Thus we came in to a contradiction that the installation of a lift is not an easy task and high installation cost. As compared with the other lifting mechanism, rack and pinion lift mechanism does not need any separate machine rooms. Well-designed Rack and pinion lifts are more compact and saves effort and time.

S.Mahendran,K.M.Eazhil,L.Senthil Kumar et al. carried out design and analysis of composite spur gear. This project includes design of the spur gear to study the weight

reduction and stress distribution for cast steel and composite materials. They designed the spur gear model using design software and studied the impact analysis and torque loading for cast steel and composite materials. Finally, by comparing and analysing the composite gear with existing cast steel gear they concluded that the stress induced, deformation and weight of the composite spur gear is less as compared to the cast steel spur gear.

II Conclusion

Its Conclude that to improve the steering geometry i.e. reverse Ackerman geometry, which helps the driver to avoid the negative effect of cornering forces acting on vehicle &. Increases the space in cockpit area and the comfort of driver. Steering geometry can be optimized by using mathematical model for Ackerman condition for different inner wheel angles and select geometry for which percentage Ackermann as well steering effort is optimum. The composite material increases the strength of rack & pinion & reduces the weight of system which helps to reduce gross weight of vehicle. The weight Composite Material is reduced as compared to others material which is turn result in improved power transmission which overall improve the efficiency of the system.

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