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Design and fabrication of rocker bogie suspension system: A Review

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ABSTRACT

The place, where the value of gravity remain lower than earth's own gravitational coefficient, at that place the existing suspension system fails to fulfil desired results as the amount and mode of shock absorbing changes. To counter anti-gravity impact, NASA and Jet Propulsion Laboratory have jointly developed a suspension system called the rocker-bogie Suspension system. It is basically a suspension arrangement used in mechanical robotic vehicles used specifically for space exploration . The proposed suspension system is currently the most favored design for every space exploration company indulge in the business of space research. The motive of this research initiation is to understand mechanical design and its advantages of Rocker-bogie suspension system in order to find suitability to implement it in conventional loading vehicles to enhance their efficiency and also to cut down the maintenance related expenses of conventional suspension systems.

Keywords: exploration, roker-bogie, suspension, efficiency, design

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I. INTRODUCTION

In rocker bogie suspension system, the term rocker" describes the rocking aspect of the larger links present each side of the suspension system and balance the bogie as these rockers are connected to each other and the vehicle chassis through a selectively modified differential.

As accordance with the motion to maintain center of gravity of entire vehicle, when one rocker moves up-word, the other goes down. The chassis plays vital role to maintain the average pitch angle of both rockers by allowing both rockers to move as per the situation. As per the acute design, one end of a rocker is fitted with a drive wheel and the other end is pivoted to a bogie which provides required motion and degree of freedom.

In the system, "bogie" refers to the conjoining links that have a drive wheel attached at each end. Bogies were commonly used to bare loading as tracks of army tanks as idlers distributing the load over the terrain. Bogies were also quite commonly used on the trailers of semi-trailer trucks as that very time the trucks will have to carry much heavier load.

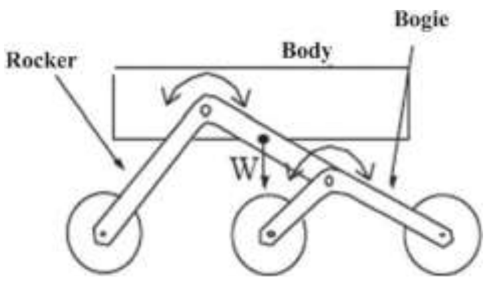

Fig.1. 2D Line diagram of Rocker-bogie suspension system and its motile joints.

II. LITERATURE REVIEW

Nitin Yadav et. al. studied the place, where the value of gravity remains lower than earth's own gravitational coefficient, at that place the existing suspension system fails to fulfil desired results as the amount and mode of shock absorbing changes. To counter

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anti-gravity impact, NASA and Jet Propulsion Laboratory have jointly developed a suspension system called the rocker-bogie Suspension system. It is basically a suspension arrangement used in mechanical robotic vehicles used specifically for space exploration. The rocker-bogie suspension based rovers has been successfully introduced for the Mars Pathfinder and Mars Exploration Rover (MER) and Mars Science Laboratory (MSL) missions conducted by apex space exploration agencies throughout the world. The proposed suspension system is currently the most favoured design for every space exploration company indulge in the business of space research. The motive of this research initiation is to understand mechanical design and its advantages of Rocker- bogie suspension system in order to find suitability to implement it in conventional loading vehicles to enhance their efficiency and also to cut down the maintenance related expenses of conventional suspension systems.

Steven Dubowsky et. al.,Rovers will continue to play an important role in planetary exploration. Plans include the use of the rocker-bogie rover configuration. Here, models of the mechanics of this configuration are presented. Methods for solving the inverse kinematics of the system and quasi-static force analysis are described. Also described is a simulation based on the models of the rover's performance. Experimental results confirm the validity of the models.The model has been implemented into a simulation. It shows the rover in its environment, moving over specified terrains and is a valuable tool for evaluation. A graphical interface has also been developed, to enhance the understanding of the system. A number of variables useful for performance evaluation are computed and displayed including the normal forces on the rover wheels. The torque saturation for each wheel (the ratio between the actual torque and the saturation torque), the slip ratio Sr that is defined and computed as: Sr = μ , where Ti, Ni and μ are the traction and normal forces and the local coefficient of friction under the wheel respectively are also shown. Stability margin is defined as the ratio between the angle necessary to tip over the rover at a given time and the angle to tip over the rover when on a flat surface. The kinematics parameters (link lengths, etc) can be changed during the simulation, therefore the simulation can be used for optimisation studies. Other control panel keys interface with the user, such as Pause, Play Fast Forward, etc. buttons. This way, the user can focus on specific areas.A simple and computationally efficient rocker-bogie rover model is presented. Under reasonable assumptions, it is possible to determine the rover attitude and configuration, given its position and ground characteristics, and whether the rover will slide, tip over or maintain its balance. The model includes the affect of the manipulator. The mechanics of the rover has been developed, and the over-actuation of the system leads to the ability to affect the normal forces by applying specific wheel torques. This property has been verified experimentally and can be used for the design of an active traction control. A graphical interface has been designed to enhance understanding of the system.

David P. Miller et.al., The Rocker-Bogie Mobility system was designed to be used at slow speeds. It is capable of overcoming obstacles that are on the order of the size of a wheel. However, when surmounting a sizable obstacle, the vehicles motion effectively stops while the front wheel climbs the obstacle. When operating at low speed (greater than 10cm/second), dynamic shocks are minimized when this happens. For many future planetary missions, rovers will have to operate at human level speeds (~1m/second). Shocks resulting from the impact of the front wheel against an obstacle could damage the payload or the vehicle. This paper describes a method of driving a rocker-bogie vehicle so that it can effectively step over most obstacles rather than impacting and climbing over them. Most of the benefits of this method can be achieved without any mechanical modification to existing designs – only a change in control strategy. Some mechanical changes are suggested to gather the maximum benefit and to greatly increase the effective operational speed of future rovers.One of the major shortcomings of current planetary rovers is that they are slow. In order to be able to overcome significantly rough terrain (i.e., obstacles more than a few percent of wheel radius) without significant risk of flipping the vehicle or damaging the suspension, these robots move slowly and climb over the obstacles by having wheels lift each piece of the suspension over the obstacle one portion at a time.

II. CONCLUSION

The proposed paper produces a novel design in pursue of increasing the rocker-bogie mobility system in conventional heavy loading vehicle behaviour when high-speed traversal is required. Presented situation was faced presenting two modes of operation within same working principle which is a rocker-bogie system with a robust obstacles traverse features and another is an expanded support hexagon achieved by rotating the bogies of each side of the vehicle. The proposed modification increases in the stability margin and proved with valuable and profitable contrasting the SSF metric with the 3D model simulations done in SOLIDWORKS. In future, if the system installed in heavy vehicles and conventional off road vehicles, it will definitely decrease the complexity as well as power requirements to retain bumping within it. A conclusion section must be included and should indicate clearly the advantages, limitations, and possible applications of the paper. Although a conclusion may review the main points of the paper, do not replicate the abstract as the conclusion. A conclusion might elaborate on the importance of the work or suggest applications and extensions.

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