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DESIGN OF ROCKER-BOGIE WITH SUSPENSION SYSTEM

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ABSTRACT-.The Rocker-Bogie system was designed for slow speeds. It is capable of overcoming obstacles that are of double the size of a wheel. The primary mechanical feature of the rocker bogie design is its drive train simplicity, which is accomplished by using six motors for mobility. All motors are located at each wheel where thermal variation is kept to a minimum, increasing reliability and efficiency. Six wheels are used because there are many obstacles on natural terrain that require both front wheels of the rover to climb simultaneously. A series of mobility experiments in the agriculture land, rough roads, inclined, stairs and obstacles surfaces concluded that rocker bogie can achieve some distance traverses on field.

Keywords: Rocker bogie; terrain; Stair climbing; obstacles.

I. INTRODUCTION

Over the few years, the rocker-bogie suspension design has become a more useful application known for its superior vehicle stability and obstacle-climbing capability. Following several technology and research rover implementations, the system was successfully flown as part of NASA'S rover. The primary mechanical feature of the Rocker Bogie design is its drive simplicity, which is fulfilled by two rocker arms. In order to overcome an obstacle, the front wheels are forced against the obstacle by the rear wheels. Due to the rotation of front wheel then lifts the front of the vehicle up and over the obstacle. The middle wheel is pressed against the obstacle by the rear wheel and pulled over the obstacle by the front, until it is lifted up and over. Finally, the rear wheel is pulled over the obstacle by the front wheels. During each wheel's forward motion over the obstacle, forward progress of the vehicle is slowed. These rovers move slowly and climb over the obstacles by having wheels lift each part of the suspension over the obstacle one portion at a time [1].

One of the major shortcomings of current rocker-bogie rovers is that they are slow in speed. In order to overcome rough terrain (i.e. obstacles more than a few percent of wheel radius) without significant risk of ramming the vehicle or damaging the suspension system. While performance on rough surface obstacles is important, it should be also considered as the surface is flat or it has almost imperceptible obstacles.

In this paper, the authors propose modifications in the structure of the rocker-bogie system increasing the span of the support polygon in ability of achieving a greater stability margin over high-speed traversal without losing the original configuration [2].

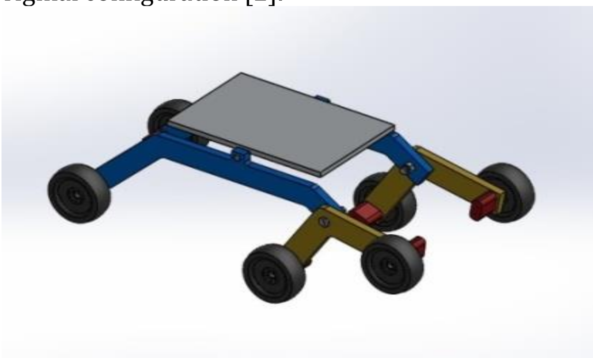

Fig 1: Rocker bogie

II. LITERATURE REVIEW

This paper presents a novel design in pursue of increasing the rocker-bogie mobility system in conventional heavy loading vehicle behavior when high speed traversal is required. Presented situation was faced two modes of operation within same working principle are as follows,

1. Rocker-bogie system with a robust obstacles traverse features.

2. An expanded support hexagon achieved by rotating the bogie of each side of the vehicle.

The proposed modification increases in the stability margin and proved with valuable and profitable contrasting the static stability factor (SSF) metric with the 3D model simulations done in solid work. In future, if the system installed in heavy vehicles, it will surely decreases the complexity as well as power requirements to retain bumping within it. This is a wide field of study and is very less explored. [1]

The design under consideration shows it was practically able to climb twice the wheel diameter because of the limitations explained above. On the other hand the single existing rocker bogie rover has its limitation to climb a maximum of twice the diameter of wheel. Changing the design has resulted in increase of height climbed but has reduced its stability because of more height of vehicle from ground level that increases the distance of cg. The power consumption is found to be minimum on sand hill and maximum when climbing the steps but since the modified rover uses more number of wheels and motor the power consumption is high. Pit test and sand hill test shows that the vehicle can climb a maximum elevation of about 50^0 (degrees) [3].

The trainability is an important characteristic should be included in aterrestrial's vehicle during the postdisaster occurrence. This ability helps the vehicle reducing a flipping back and slippage while it on a mission since the terrain surface after a disaster is despotic. Thus, applying the controller algorithm will optimizing the vehicle ability to man oeuvre in any surface condition with minimum risk. [4]

III. Problem statement:

- The main purpose of rocker bogie fabrication is to develop a bogie with no spring suspension &no stub axle in each wheel which allows the chassis to climb over any obstacles.
- The analysis of the suspension system which is bell crank lever is done with the help of ansys software which indicates the problem facing by bell crank lever on the uneven surfaces.
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IV. OBJECTIVES

As we clearly identified the problem and solution methods through the various literatures, now the objective of the research is as follows

- To construct rocker bogie with proper design.
- To study and measure the reaction force produced by terrain surfaces on wheel and on suspension system.
- One of the shortcoming of current rocker bogie are slow, overcoming this problem by dynamically balancing of rocker bogie.
- To compare the experimental results with the theoretical results.

V. DESIGN OF ROCKER BOGIE SUSPENSION SYSTEM

COMPONENT OF ROCKER-BOGIE

1. **Motor**:-An electric motor is an electrical device that converts electrical energy into mechanical energy. For rocker- bogie we select the six DC motors, i.e. one for each wheel.
   Motor specifications,
   12Volt, 60 RPM, 6 mm shaft dia.,
   Load current= 60ma (max)
   No load current=300 ma (max)
   Torque =2.482 N-m

2. **Wheel**:-
   Wheel torque free body diagram
   $F_g = \frac{mr.g}{4}$ [5]
   $= \frac{6 \times 9.81}{4}$
   =4.905 N
   Where r_w is the radius of wheel=35 mm
   $T_w = F_g \times r_w$ [5]
   =4.905×0.035
   =0.1712 N-m
   Each wheel required 0.1712N.m of torque

3. **Length of Links**
   Total wheel base=600mm
   Distance between front two wheel is consider as 250 mm
   Let us assume angle $\theta = 45°$

   Height Calculation height^2=BC^2-NC^2
   $=(270^2-100^2)^{1/2}$
   =250
   Net height = 250+35=285mm

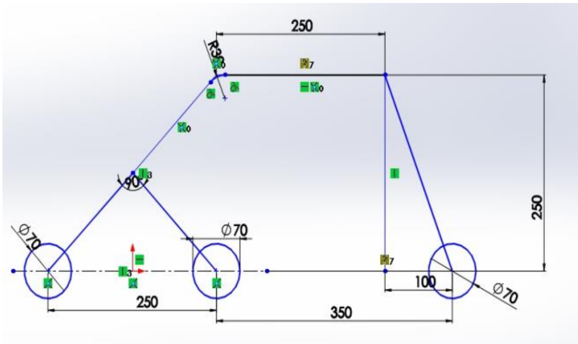

Fig 2 : Rocker bogie dimensions

VI. CONCLUSION

In this thesis work we have analyzed the six wheeled rocker-bogie rover. The Kinematics of the rover is presented in detail and quasi-static force analysis is also done for the rover for planar case. The bond graph model for the rover is developed which represents the dynamics of the system andmotor dynamics is also added to the system. The rover is simulated over various uneven terrains and the performance of the rover is analyzed over flat, slope, step and ditch profile of surface. The results of simulation show that rover crosses flat and slope profiles. In case of step profile only front wheel crosses the step, when middle wheel hit the step the velocity becomes zero and it is not able to climb. In case of ditch profile also only front wheel crosses the ditch, when middle wheel hit the up of ditch the velocity goes to zero and it is not able to climb.

VII. ACKNOWLEDGMENT

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