"ROCKER BOGIE SUSPENSION SYSTEM"

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ABSTRACT

Rocker bogie are important for conducting in-situ scientific analysis of objectives are separated by many meters to tens of kilometers. Current mobility designs are complicated, using many wheels or legs. They are open to mechanical failure caused by the severe environment on Mars. A six wheeled rover capable of travel across rough terrain using an efficient high degree of mobility suspension system. The primary mechanical feature of the rocker bogie design is its drive train simplicity, which is accomplished by using only two motors for mobility. The motors are located inside the body where thermal variation is kept to a minimum, increasing efficiency and reliability. six wheels are used because there are some obstacles on natural terrain that require both front wheels of the rover to climb at the same time. A series of mobility experiments in the agriculture land, , inclined, stairs rough roads and obstacles surfaces concluded that rocker bogie can achieve some distance traverses on field.

Keywords*: Rocker bogie; Wheel type mobile robot; Stair climbing; Rover*.

1. INTRODUCTION

The Rocker-Bogie design has no stub axles and springs for every wheel, allowing the mover to climb over obstacles, such as rocks, stone rough surface that are up to twice the wheel's diameter in size and shape while keeping all six wheels on the ground or road surface. In any suspension system, the tilt stability is limited by the height of the center of gravity. These Systems using springs tend to top more easily as the loaded side yields. The system is designed to be used at slow speeds of around 10 cm/s, so as to minimize dynamic shocks and considerable damage to the vehicle The term "rocker"comes from the rocking aspect of the lengthy links on each side of the suspension system. These rockers are connected to each other and the vehicle chassis through a differential. Relative to the chassis, when one rocker moves up, at the same time other goes down. The chassis maintains the average pitch angle of both rockers. One end of a rocker is fitted with a drive wheel and the other end is circulate to a bogie.

The method accomplished on real-time measurements of wheel/ground contact forces, which are difficult to measure in practice. Traction can also be improved by monitoring the sliding of the mover wheels on the ground. The detailed models of the full 3-D mechanics of rocker-bogie movers have not been developed. Further models including the designer's influence are also required to effectively planning and controlling the actions of these rovers. For example it is important for a planner to be able to indicate if a mover can successfully negotiate a given terrain obstacles, such as a desert, without being trapped.

2. LITERATURE SURVEY

The beginning of rocker bogie suspension system can be sketched to the development of planetary mover which are mobile robots, especially designed to move on a planet surface. Early movers were tele-operated like the Lunokhod, while recent ones are fully automotive, such as FIDO, Discovery and recently developed Curiosity mars exploration mover. The movers needed to be very reliable and robust, as it has to withstand strong winds, dust, corrosion and large temperature changes under difficult conditions. Maximum movers remain powered by batteries which are recharged by DC electric supply& solar panels during the day installed over there surface. The locomotive system of movers remains crucial to enable it to reach objective sites, collect data, conduct research, and to position itself according to the demand. There are three main types of mover locomotion developed so far i.e. wheeled, caterpillar and legged locomotion. The main difference between the different designs of planetary robots lies in the type of locomotion system. Even after developing many legged and hybrid robots, most researchers still focus on wheeled locomotive for movers because of its locomotive ease advantages and among wheeled locomotion design.the rocker bogie suspension system based design remain most favored

3. COMPONENT

3.1 Acrylic Stripe:

Acrylic fibers are synthetic fibers which are made up from a polymer (polyacrylonitrile) with an average molecular weight of approximately ~100,000, about 1900 monomer units. To be called acrylic in the U.S, the polymer must contain at least 85% acrylonitrile monomer. Essential commoners are vinyl acetate or methyl acrylate. DuPont invented the first acrylic fibers in 1941 and trademarked them under the name Orlon. Acrylic is also called acrilan fabric.[1] It was first established in the mid-1940s but was not produced in large quantities until the 1950s. Strong and warm, acrylic fiber is often used for tracksuits and sweaters as linings for boots and gloves, as well as in furnishing carpets and fabrics. It is manufactured in a small filament, then cut into short staple lengths similar to wool hairs, and spun into yarn. Mod acrylic is a modified acrylic fiber that contains at least 35% and at most 85% acrylonitrile monomer. The commoners vinyl chloride, vinylidene chloride or vinyl bromide used in mod acrylic give the fiber flame retardant properties. End-uses of mode acrylic include wigs, faux fur, protective clothing hair and extensions. Acrylic is, soft, lightweight and warm, carpets with a wool-like feel. It also made up from mimic other fibers, such as cotton, when spun on short staple equipment.

fig 3.1 . Acrylic Material

3.2 DC Motors

The Armature produces torque and voltage under the action of the magnetic field .DC motor is the most commonly used actuator in robotics applications. An actuator is an device which are used to produce motion. DC motors are used to drive wheels from one location to another. They are also used to power grippers, arms and weapons (fighting robots). Normally a DC Motor with inbuilt gear box is preferred. One such motor is shown below. The motors are normally consumes 400ma to 1000ma current and works off 12volt DC Supply. The shaft is appropriate with commonly available hobby robotics wheels. The DC motors are available in many different RPM (Revolution per Minutes). Example: 60 RPM, 100 RPM and 160 RPM.

Fig no.3.2 DC motor

3.3 Rectifier unit:

The power supply unit, rectification is normally obtained using a solid state diode. Diode has the property that will let the electron flow easily in unidirectional at proper biasing condition. As AC is applied to the diode, electrons only flow when the cathode and anode is negative. Reversing the polarity of voltage will not be permit to electron flow.

The commonly used circuit for supplying large amounts of DC power is bridge rectifier. The bridge rectifier of four diodes (4*IN4007) are used to obtain full wave rectification. The Two diodes will conduct charges during the negative cycle and the other two will conduct during the positive half cycle. The DC voltage appearing across the output terminals of the bridge rectifier will be somewhat lass than 90% of the applied rms value. Normally one alteration of the input voltage will reverse the polarities. Opposite ends of the transformer will therefore always be 180 deg out of phase with each other.

In positive cycle, two diodes are connected to the positive voltage terminal at the top winding and only one diode conducts. At the same time one of the other two diodes conducts for the negative voltage terminal that is applied from the bottom winding due to the forward bias for that diode. In this circuit due to positive half cycleD1 & D2 will conduct to give 10.8volt pulsating DC. The DC output has a breaker frequency of 100Hz. Since each altercation produces a resulting output wave, frequency = 2*50 Hz. The output obtained from rectifier unit is not a pure DC and therefore filtration has to be done.

3.4 Filtering unit

Filter circuits which are usually capacitors acting as arise arrester always follow the rectifier unit. This capacitor is also called as a bypassing capacitor or decoupling capacitor , is used not only to „short" the breaker with frequency of 120Hz to ground but also to exit the frequency of the DC to appear at the output. A load resistor R1 is connected so that a reference to the ground is maintained at C1R1 is for bypassing ripples,C2R2 is used as a low pass filter, i.e. it passes high frequency signals and low frequency signals. The load resistor should be 1% to 2.5% of the load.

1000∝f/25v : the reduction of ripples from the pulsating.
10∝f/25v : maintaining the stability of the voltage at the load side.
O, 1∝f : bypassing the high frequency disturbances.

3.5 Voltage regulator:

The voltage regulators are playing an important role in any power supply unit. The primary purpose of an voltage regulator is to aid the rectifier and filter circuit in providing a constant DC voltage to the device. Power

supplies without regulators have an integrated problem of changing DC voltage values due to variations in the load or due to fluctuations in the AC liner voltage. With a regulator connected to the DC output, the voltage can be maintained within a close tolerant region12v and –12v DC supply.

IC7805 and 7905 is used in this project for providing +5v and –5v DC s of the desired output. IC7812 and 7912 is used in this p

3.6 Switch:

Switch is an electrical component that can break an electrical circuit, diverting it from one conductor to another and interrupting the current. The mechanism of a switch may be operated directly by a human operator or automatic control a circuit (for example, a light switch or a keyboard button), may be operated by a moving object such as a door-operated switch, or may be operated by some sensing element for temperature, pressure or flow. A relay is a switch that operates over the electricity. Switches are made to handle a wide range of current and voltages very large switches may be used to isolate high-voltage circuits in electrical powerstation. The most familiar form of switch is a hand operated electromechanical device with one or more sets of electrical contacts, which are connected to external circuits. Each set of contacts can be in one of two states: either "open", meaning the contacts are separated and the switch is non-conducting "closed" meaning the contacts are touching and electricity can flow between them, or. The mechanism actuating the transition between these two states closed or open can be either a "*toggle*" (flip switch for continuous "on" or "off") or "*momentary*" (push-for "on" or push-for "off") type.

4. DESIGN SPECIFICATION:-

1.Diameter of wheel

$$V = \pi DN/60$$

Assumed speed be 10 cm/s i.e 100mm/s

Therefore,

$$100 = \pi DN/60$$

$$DN = 1909.86$$

So the selected D-N combination is

D=100

N=19.1 rpm

Calculations of links,

Length of link

Total wheel base= 500mm

$$\theta = 45° NC^2$$

In triangle BNC, Angle NCB = $45°$

Therefore,

NC= NB

$$NC^2 + NB^2 = BC^{2250^2}$$

$$BC^2 = 2NC^2 \qquad \text{……(1)}$$

$$= 2\ (250^2)$$

BC = 333.33

Therefore,

Rounding of to 300mm

BC = 300mm

Length of links

Substituting to equation (1), we get

$$(300)^2 = 2(NC^2)$$

NC = 250mm

AN = NC =250mm

Also,

In triangle AMN, Angle AMN = $90°$

$$2AM^2 = AN^2$$

$$2AM^2 = (250)^2$$

AM =150mm

Now, due to symmetry,

AM = MN = 150mm

BM = AB – AM

= 300 – 150

= 150

Therefore, BM = 150mm

Density of acrylic material = 0.00118 gm/mm^3

Weight of rocker arm,

= 2(300 × 50 × 3 × 0.00118)

+ 2(270 × 50 × 3 × 0.00118)

+ 4(130 × 50 × 3 × 0.00118)

= 293.82 gm.

Density of cast iron = 0.00785 gm/mm^3

Weight of shaft,

= 2($\pi/4$ × 6 × 6 × 305 × 0.00785)

=135.40 gm.

Weight of bogie,

= 120 gm.

Weight of motors,

= 6 × 125

= 750 gm.

Weight of wheel,

= 70 × 6 = 420 gm.

Total weight = 293.82 + 135 + 120 + 750 + 420

= 1719.22 gm.

Fig- 4 Actual set up

.

5.CONCLUSION:-

This work shows how rocker bogie system works on different surfaces. As per the different weight acting on link determines torque applied on it. By assuming accurate stair dimensions, accurately dimensioned rocker bogie can climb the stair with great stability. The design and manufactured model can climb the angle up to 45˚. Also we tested for the Web cam with AV recording mounted on rocker bogie system and found satisfactorily performance obtains during this test wheels are rotated around 360˚. During stair climbing test for length less than 375 mm (15 inch) system cannot climb the stair. It can be possible to develop new models of rocker bogie which can climb the stairs having low lengths.

5.1ADVANTAGES:-

- Load on each wheel is nearly similar.
- It has no axles and springs which helps to maintain equal traction force on all the wheels.
- It Can climb over blocks twice the height of the wheel while keeping all 6 wheels on the ground.
- Each wheel can individually lift almost the whole mass.
- Distribute the weight and drive torque to six wheels instead of four wheel & gives the mover greater tractive effort and stability.

5.2 APPLICATIONS:-

- In military purposes for material transfer & border security.
- Space research & path finder.
- It can be used as in robots.

REFERRENCE

[1] P. Panigrahi, A. Barik, Rajneesh R. & R. K. Sahu, "Introduction of Mechanical Gear Type Steering Mechanism to Rocker Bogie",Imperial Journal of Interdisciplinary Research (IJIR) Vol-2, Issue-5, ISSN: 2454-1362,2016.
[2] A. Bhole, S. H. Turlapati, Raja shekhar V. S, J. Dixit, S. V. Shah,Madhava Krishna K, "Design of a Robust Stair Climbing Compliant Modular Robot to Tackle Overhang on Stairs"arXiv:1607.03077v1 [cs.RO], 11 Jul 2016.
[3] M. D. Manik, A. S. Chauhan, S. Chakraborty, V. R. Tiwari,"Experimental Analysis of climbing stairs with the rocker-bogie mechanism", Vol-2 Issue-2 P.No. 957-960IJARIIE-ISSN(O)-2395-4396, 2016.
[4] B. D. Harrington and C. Voorhees, "The Challenges of Designingthe Rocker-Bogie Suspension for the Mars Exploration Rover", Proceedings of the 37th Aerospace Mechanisms Symposium, Johnson Space Center, page No. 185-1985, May 19-21, 2004
[5] Y. L. Maske, S. V. Patil, S. Deshmukh, "Modeling and MBD simulation of stair climbing robot with rocker bogie Mechanism", International Journal of Innovative Research in Technology, 101743, Volume 1 Issue 12, Page no. 267-273,ISSN: 2349-6002, 2015.