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Weight Carrying Rover

Vegeesh.V[1], Subramaniya Sedhupathy.S[2], Suresh.R[3], Tamizharasan.D[4], Mr. S. Narayanan[5]
[1,2,3,4]*Department of Mechanical Engineering, SNS College of Engineering, Coimbatore*
[5]*Assistant Professor, Department of Mechanical Engineering, SNS College of Engineering, Coimbatore*

***Abstract* - The Project work "Rocker Bogie mechanism Geo survey Rover" deals with the important aspect of improving the rover from its previous designs. The Geo survey rover has to operate on rough and harsh environments for which it was designed but several factors restrict its operational capabilities, so the focus of our research is to overcome restrictions or to decrease it to within an acceptable range for its smooth performance. Our research on the restrictions of the rover conducted by our team focused mainly on the drive system and its drive modules which were not efficient, the linkage, the overturning or tilt range of the rover and the battery inefficiency from the other restrictions and problems that were obtained from the literature review and research so, we conducted research on how to improve that. The rover has been completely made from steel pipe to increase its capability to withstand shocks, vibrations and mechanical failures caused by the harsh environment where it is operated on. Using CAD software, the design of the rover has been fine-tuned and by experimenting with prototypes and models of the rover in the experimental setup of the live test, improvements and feature were included into the Geosurvey rover.**

I.INTRODUCTION

Rocker bogie is important for conducting in-situ scientific analysis of objectives that are separated by many meters to tens of kilometers. Current mobility designs are complex, using many wheels or legs. They are open to mechanical failure caused by the harsh environment on Mars. A four wheeled rover capable of traversing 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. Both motors are located inside the body where thermal variation is kept to a minimum, increasing reliability and efficiency. Four wheels are used because there are few 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.

II.COMPONENTS AND DESCRIPTION

The major components involved in the fabrication of the Weight Carrying Rover are as follows:

1. Base Frame (Vehicle arrangement)
2. Wheel
3. DC Motors
4. Battery

In any electric motor, operation is based on simple electromagnetism. A current-carrying conductor generates a magnetic field; when this is then placed in an external magnetic field, it will experience a force proportional to the current in the conductor, and to the strength of the external magnetic field. As you are well aware of from playing with magnets as a kid, opposite (North and South) polarities attract, while like polarities (North and North, South, and South) repel. The internal configuration of a DC motor is designed to harness the magnetic interaction between a current-carrying conductor and an external magnetic field to generate rotational motion.

CALCULATIONS

Motor specification
Rpm =30
Volt= 12
Watt = 18
I = V / R
where I – current, measured in amperes (A).
V – applied voltage, measured in volts (V).
R – resistance, measured in ohms (Ω).
The consumed electrical power of the motor is defined by the following formula:
Pin = I * V
where Pin – input power, measured in watts (W).
I – current, measured in amperes (A).
V – applied voltage, measured in volts (V).

$P_{out} = \tau * \omega$

where Pout – output power, measured in watts (W).

τ – torque, measured in Newton meters (N•m).

ω – angular speed, measured in radians per second (rad/s).

It is easy to calculate angular speed if you know rotational speed of the motor in rpm:

$\omega = rpm * 2\pi / 60$

where ω – angular speed, measured in radians per second (rad/s).

rpm – rotational speed in revolutions per minute.

π – mathematical constant pi (3.14).

60 – number of seconds in a minute. Measuring the torque of the motor is a challenging task. It requires special expensive equipment. Therefore, we suggest calculating it.

Efficiency of the motor is calculated as mechanical output power divided by electrical input power:

$E = P_{out} / P_{in}$

After substitution we get

$T * \omega = I * V * E$

$T * rpm * 2\pi / 60 = I * V * E$

And the formula for calculating torque will be

$\tau = (I * V * E * 60) / (rpm * 2\pi)$

$\tau = (0.22 * 6 * 0.1 * 60) / (1000 * 2 * 3.14) = 0.00126$ N•m

As the result is small usually it is expressed in millinewton meters (mN•m). There is 1000 mN•m in 1 N•m, so the calculated torque is 1.26 mN•m. It could be also converted further to still common gram force centimetres (g-cm) by multiplying the result by 10.2, i.e., the torque is 12.86 g-cm.

In our example input electrical power of the motor is 0.22 A x 6 V = 1.32 W,

Output mechanical power is,

1000 rpm x 2 x 3.14 x 0.00126 N•m / 60 = 0.132 W.