International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 07 Issue: 09 | Sep 2020 www.irjet.net p-ISSN: 2395-0072

Electricity Generation by Suspension Cushioning

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Abstract - The main objective of designed the controller for a vehicle suspension system is to reduce the discomfort sensed by passengers which arises from road roughness and to increase the ride handling associated with the pitching and rolling movements. In our project, we used spring, rack & pinion arrangement and doubly fed induction generator. As shock absorber effect formed, spring is compressed and linear movement of rack is converted in rotary motion due to pinion moves as the rack is meshed with pinion. And the pinion is mounted on the shaft which is connected to shaft of doubly fed induction generator. Due to this arrangement, rotary motion of pinion is used to rotate generator. As generator rotation leads to generation of energy. And this energy is used to charge the battery and this stored energy is used for different vehicle accessories like power window, lights and air conditioner etc.

Keywords: shock absorber, Regenerative suspension, Rack and pinion etc.

1. INTRODUCTION

In the past decade, regenerative braking systems have become increasingly popular, recovering energy that would otherwise be lost through braking. Fossil fuels are being consumed with very fast rate. Also the cost of fuel is increasing with a very fast rate. So somebody has to work on saving of the fuel consumption. Our aim is to demonstrate how the kinetic energy from the suspension of a car can be utilized to achieve our goal of obtaining maximum energy that would otherwise have gone waste.

In our project, we used bearing, rack & pinion arrangement and doubly fed induction generator. As shock absorber effect formed, oil is compressed and linear movement of rack is converted in rotary motion due to pinion moves as the rack is meshed with pinion. And the pinion is mounted on the shaft which is connected to shaft of doubly fed induction generator. Due to this arrangement, rotary motion of pinion is used to rotate generator. As generator rotation leads to generation of energy. And this energy is used to charge the battery and this stored energy is used for different vehicle accessories like power window, lights and air conditioner etc. We have decided to work on utilization of suspending mass of a vehicle through regeneration system with the help of shock absorber.

2. PROBLEM DEFINATION

If there should arise an occurrence of Induction Brakes, entire framework can experience disappointment due to electric engine. This venture is that it is basic in development and structure and has low in cost. It is effectively mounted on the safeguard of the vehicle and it created 2 to 3 volts in even street and 6 to 9 volts on uneven bar which is adequate for charging the vehicle battery when the vehicle is in a running position. This expands the effectiveness of electric vehicles up to 10%. Further improvement in the suspension configuration makes it appropriate for any bikes (electric). By expanding the no. of DC engine age of intensity get expands which are utilized to charge high voltage battery. This framework can be utilized on to the mono suspension framework by making reasonable plan. By altering this framework we can actualize this on to the electric bicycle.

3. METHODOLOGY

Methodology is generally a guideline system for solving a problem, with specific components such as phases, tasks, techniques and tools.

- **PROBLEM IDENTIFIED**

  Power which is wasted in ordinary shock absorber in the form of heat.

- **NEED OF THE WORK**

  To store the free vibration energy in the battery which is being wasted in conventional shock absorber.

- **SOLUTION FOR THE PROBLEM**

  A part of power is recovered using model.

- **FEASIBILITY STUDY**

  Make sure of resource availability for the project.

- **DESIGN**

  Making calculations for the feasible one and analyzing it for the design.

- **IMPLEMENTATION AND TESTING**

  Fabrication of various components as per the feasible design and assembling the same and trialing it out on.

3.1 WORKING

In this project we have to develop a suspension energy generation unit by using belt and pulley.

Here, when the vehicle suspension works, the linear motion of the suspension creates friction between the pulleys and the belt. Due to this, the pulley starts rotating. The pulleys are mounted on the shaft of the DC motors. As the pulleys get rotated the shaft of the motors also get rotated which generate electricity. The figure shows the implementation of the project and its working there, As the vehicle passes over an uneven road surface, there is relative motion of the individual wheels. As shown, the linear motion of the wheels causes the suspension to compress and this imparts motion to the belt which is attached to the wheel assembly. This in turn gives rotational motion to the pulley as shown in the highlighted area. The belt then transfers the rotary motion through pulley to the DC motors. The motors generates electricity which is the given to the various auxiliaries of the vehicle. The project assembly thus includes one front wheel, suspension and the designed units attached to it.

3.2CONSTRUCTION

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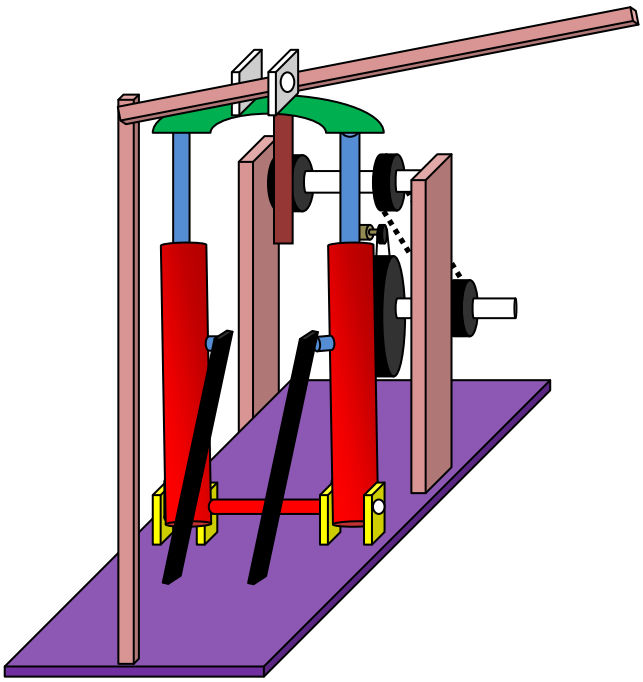
3.3 DESIGNING

It consist of two shock absorber, two motor, two pulley, rack and pinion and frame. On the frame two shock absorber, bearing, motor are mounted. Rack is attached to shock absorber and pinion is attached to shaft.



3.4 CALCULATION

3.4.1Design of bolt

Bolt is to be fastened tightly also it will take load due to rotation. Stress for C-25 steel ft. =420 kg/cm^2 Std nominal diameter of bolt is 8mm. From table in design data book, diameter corresponding to M8 bolt is 8.160mm

Let us check the strength:-

Also initial tension in the bolt when belt is fully tightened.

P =30 kg = 300 N is the value of force applied by hand

Also, P = Π /4 dc^{2}x ft

$$Ft = \frac{300 \times 4}{3.14 \times (12 \times 0.84)^2} = 3.76 \text{ N / mm}^2$$

The calculated ft is less than the maximum ft hence our design is safe.

3.4.2Design of DC motor

Motor calculation Specification and calculation:

- 60 rpm
- 12 V
- 18 W

W= rpm ×2π/60

P=ζ × w

Torque of motor: W = N× 2π/60

P= ζ× W

ζ = P/W

ζ =P × 60 /2 × 3.14 × N (1) =18 × 60/2 × 3.14 × 60 = 2.866 Nm = 2.866× 10^3 N-mm.

The motor shaft is made of MS and its allowable shear stress (Fd)= 42MPa

Torque: ζ = 3.14 × Fd × d ^{3} 16

5.72 x 10^3 = 3.14 × 42 × d ^{3}16

d = 7.031 mm

The nearest standard size is d = 8 mm.

Calculation of position of centre of gravity with respect to the rear axle

We know that turning Radius of vehicle (R) = 1500 mm.

Also we know that, Turning radius of vehicle: R= a2 2 + R1 2 (3)

Where, a2 = Distance of CG from rear axis. R1= Distance between instantaneous centre and the axis of the vehicle.

To find a2 Load on front axle: Wf=W× a2L (4)

Where, Wf = Load on front axle = 17kg (On basis weight distribution) Total weight of vehicle (W) = 30kg Wheel base (L) = 2669 mm Therefore, a2 = 1200 mm Substituting the value of a2 in the above equation R1 = 2010 mm

If load apply on the vehicle is 25kg and length 600 mm, width of vehicle 800 mm. Find the reaction force developed by each wheel and also find torque of each wheel?

Here Given Data W=25kg

Length=600 mm Width=800 mm to find reaction force on each wheel (F), torque (T)

r= ((a 2)2+ (*b*2)2)0.5 (5)

r= ((6002)2 + (8002)2)0.5 r=500 mm Now W= 25kg = 25 × 9.81 = 245.25N

Now Force on each wheel =W4 (6)

=61.32N

According to newton's 3rd law of motion Reaction Force developed by each wheel: F =W4 (7)

= 61.32N

Now Torque on each wheel: T=W4×r = 30660 N-m

3.5 COMPONENT

According to all the calculations we considered the specifications of components on market survey basis by relating the value approximately near to the calculations.

Table -2: Components

COMPONENET		
SR.NO	**PART NAME**	**MATERIAL**
1	Frame	Ms sq. section 20 ×20× 3thk MS sheet 1.5 thk.
2	Rack	M.S
3	Bearing	6024
4	Shaft	MS 20 Ø

4. ADVANTAGES AND DISADVANTAGES

4.1 Advantages

- High Efficiency, Energy Saving and Low Operating Cost Wide Operating Range
- Low Noise and Low Vibration
- Automatic Control for charging
- Robust and Simplified Structure, Low disappointment rate and high unwavering quality.
- Top Level power Efficiency, Energy Efficient Performance and Long Lasting Reliability.
- Maximum Accessibility and Total Connectivity.

4.2 Disadvantages

- Not applicable for all types of two wheelers.
- On smooth road power generation is less than 4 volt.

- Design of the suspension system not suitable for scooter.
- As whole system consist of electric wiring, so that chances of short circuits.

5. FUTURE SCOPE

The scope for this project is that it is simple in construction and design and has low in price. It is easily mounted on the chassis of the vehicle and it produced 2 to 3 volts in even road and 6 to 9 volts on uneven rod which is sufficient for charging the vehicle battery when the vehicle is in a running position. This increases the efficiency of electric vehicles up to 10%. Further improvement in the suspension design makes it suitable for any two wheelers (electric). By increasing the no. of DC motor generation of power get increases which are used to charge high voltage battery. This system can be used on to the mono suspension system by making suitable design. By modifying this system we can implement this on to the electric car

6. CONCLUSION

Conventionally, the vibration energy of vehicle suspension is dissipated as heat by shock absorber, which wastes a considerable number of resources. Power Generating by Shock Absorber brings hope for recycling the wasted energy. All types of Power Generating Shock Absorber, especially electromagnetic suspension, and their properties are reviewed in this project. From the perspective of comprehensive performance including vibration control ability, regenerative efficiency and application reliability. With improvement of technology, Power Generating Shock Absorber may become one of promising trends of vehicle industry.

7. ACKNOWLEDGEMENT

We would like to place a record of our deep sense of gratitude to S.V.Vanjari (Head of Mechanical Engineering Department), SSPM's COE Kankavli, for him generous guidance, help and useful suggestions.

We express our sincere gratitude to Prof. K.S.Kamble, Prof. E.L.Manjrekar, Prof. O.C.Salavi, Prof. S.S.Kulkarni, and Technical Assistant Mr.V.V.Yadav of Department of Mechanical Engineering SSPM's COE Kankavli for their simulating guidance and continuous encouragement throughout the course of present work.

We also wish to extend our thanks to Principal Dr.A.C.Gangal for providing us infrastructure facilities to work in, without which this work would have not been possible.

We are also grateful to our family members for their constant encouragement, extended co-operation and help.

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