Increasing Battery Life Of Electric Vehicles By Regenerative Braking System And Vehicle Suspension System

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ABSTRACT:

All vehicles have regenerative braking and suspension system. Only 26 % of the available fuel energy is used to drive the vehicle, i.e. to overcome the resistance from road friction. In a vehicle the important losses are dissipation of vibration energy by shock absorbers in the vehicle suspensionand frictional loss during the regenerative braking.This paper is made with a purpose to inform in a concise way the essence of regenerative braking, suspension system and different methods, utilized to accumulate recuperated energy. Electric vehicles are a broad but very exciting and rapidly spreading topic concerning the following needs and factors: to lower emissions in the environment, to use green energy sources, increased energy demand and consumption etc. Regenerative braking is a process of deceleration of an electric vehicle (plug-in or hybrid) by converting mechanical energy to electrical via generator operation of its motor, while also providing brake torque, and further accumulating it in storage systems. This process extends their range or lowers fuel consumption respectively. Regenerative shock absorber is a type of suspension system that converts parasitic intermittent linear motion & vibration into use full energy, such as electricity. Conventional shock absorber simply dissipates this energy as heat. A conceptual regenerative braking and suspension system is designed and tested using a fabricated prototype.

Keywords-Electric vehicles, regenerative braking system, vehicle suspension system, power generation.

1. INTRODUCTION:

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. Electric Vehicles, when invented, were a very proficient technological development, as it does not produce any emission to the air, hence no harmful gasses are released from the car that causes atmospheric pollution. The population of Electric vehicles is increasing nowadays. However, the limitation in the driving range is not yet overcome, which is still a drawback for these vehicles. Implementation of regenerative braking and suspension system has increased the driving range by 10-25%. We propose a design plan that converts the mechanical energy in vehicles to electrical energy much more efficiently than it has been done before. The electricity generated will then be used to recharge the vehicle battery for further use for functioning of the vehicle.

2. LITERATURE REVIEW:

The purpose of this literature review is to go through the main topics of interest. The literature review is concerned with design of spur gear, DC generator, Design of Shaft, selection of bearings & shock absorber with theoretical and experimental evaluation. The objective of this project is to design a regenerative shock absorber and braking system which can harness the energy.

The RBS will be used to convert the car's mechanical energy and also the heat that would have been lost during braking into electrical energy during braking. The 2 most important aspects of the design have been listed below. Power generation: In electric vehicles during braking the motor which is used to run the vehicle transforms in to a generator & the power generated is again sent to the battery and is used to run the vehicle. Braking: In RBS, conventional braking is avoided & the required breaking force is generated in the motor itself which is used to run the vehicle.

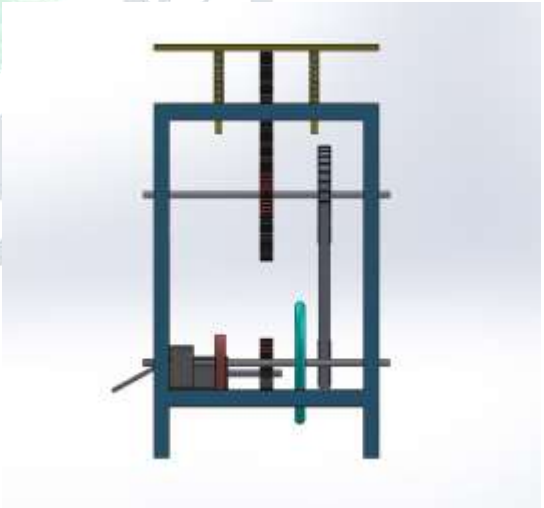
Vibration occurs between the road surface and car body when driving on irregular road surfaces. The function of regenerative shock absorbers is to recover this vibration energy, which can be dissipated in the form of heat as waste. In this paper, the development of regenerative shock absorber and braking system is reviewed.

3. NEED FOR REGENERATIVE BRAKES AND VEHICLE SUSPENSION:

The regenerative braking system delivers a number of significant advantages over a car that only has friction brakes.In low-speed, stop- and-go traffic where little deceleration is required; the regenerative braking system can provide the majority of the total braking force.This vastly improves fuel economy with a vehicle, and further enhances the attractiveness of vehicles using regenerative braking for city driving. At higher speeds, too, regenerative braking has been shown to contribute to improved fuel economy.

Shock absorbers are a critical part of a suspension system, connecting the vehicle to its wheels. An energy-harvesting shock absorber is able to recover the energy otherwise dissipated in the suspension vibration while simultaneously suppress the vibration induced by road roughness.It can work as a controllable damper as well as an energy generator. The key component is a unique motion mechanism, which we called "mechanical motion rectifier (MMR)", to convert the oscillatory vibration into unidirectional rotation of the generator.When used in an electric vehicle or hybrid electric vehicle the electricity generated by the shock absorber can be diverted to its power train to increase battery life.

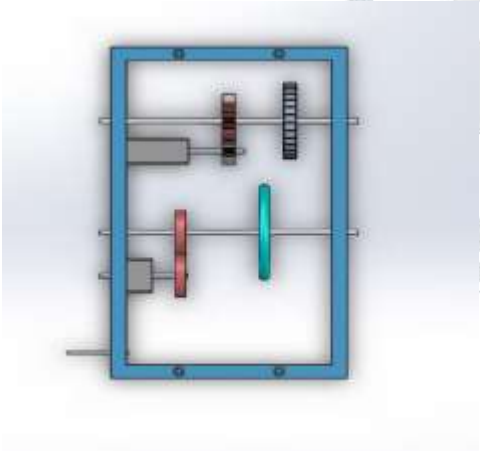
4. DESIGN:



5. COMPONENTS:

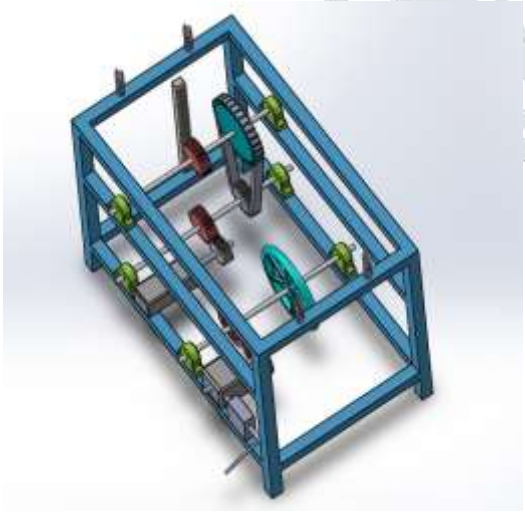
5.1 Pillow Ball Bearings:

A ball bearing is a type of rolling-element bearing that serves three main functions while it facilitates motion: it carries loads, reduces friction and positions moving machine parts. Ball bearings use balls to separate two "races," or bearing rings, to reduce surface contact and friction across moving planes.



5.2 Geared DC Generator –100rpm & 45rpm:

In electricity generation, an electric generator is a device that converts mechanical energy to electrical energy. A generator forces electric charge (usually carried by electrons) to flow through an external electrical circuit.

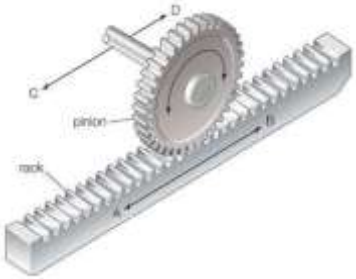


5.3 Chain Assembly:

Chain drives are used for transmitting power from one shaft to another, located at some distance.

Alsoit is used for providing rotating motion while suspension system is going.

5.4 Rack and Pinion Assembly:

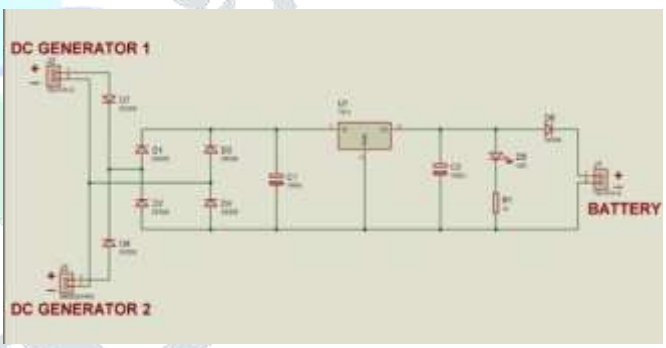


A rack and pinion is a type of linear actuator that comprises a pair of gears which convert rotational motion into linear motion. A circular gear called "the pinion" engages teeth on a linear "gear" bar called" the rack"; rotational motion applied to the pinion causes the rack to move, thereby translating the rotational motion of the pinion into the linear motion of the rack.

5.5 Springs :

A spring is an elastic object used to store mechanical energy. Springs are usually made out of spring steel. When a coil spring is compressed or stretched slightly from rest, the force it exerts is approximately proportional to its change in length (this approximation breaks down for larger deflections).

5.6 Rectifier Circuit:



Rectifier circuit consists of Full wave bridge rectifier, Capacitors, Regulator, LED bulb, Resistor, Diode, Etc. Energy created by Suspension system and Breaking system is passed through circuit and then into the battery. The electricity generated but the DC generator will be in both directions as the generator moves clockwise and anti-clockwise. To avoid the reverse flow of current we will use the full wave bridge rectifier circuit. The rectified output is then given to the battery for charging. While suspension system works the energy is created in forward as well as in reverse direction, so whatever

energy is created is converts in one direction. By using full wave bridge rectifier energy is converted in forward direction. Also the capacitors are used to reduce the fluctuations created in the system. Regulator is used to regulate a constant voltage to the battery. LED is used to indicate whatever the energy is created is storing in the battery.

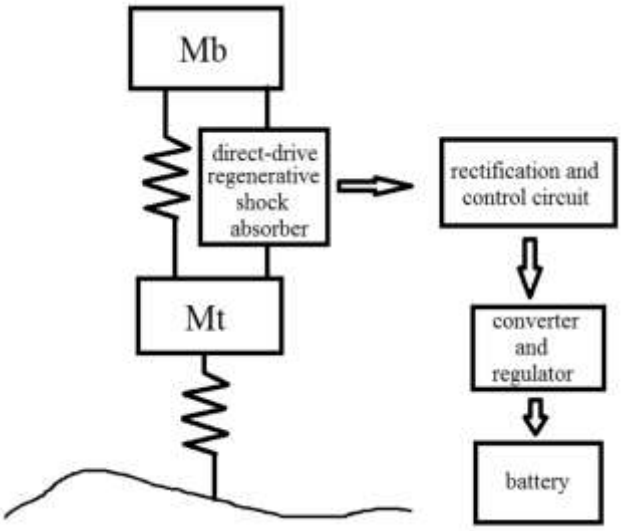
5.7 Battery:

The electricity generated is stored by using batteries. Two batteries of 6 V, 5 Amp connected in series which makes total capacity of 12 V and 5 Amp.

6. METHODOLOGY:

6.1 Energy-Regenerative Suspension System:

The system consists of following components such as suspension system, rack and pinion, doubly fed generator and embedded system. The suspension system absorbs the small vibration that is produce in the vehicle. Rack and pinion converts linear vibration motion into rotary motion. Generator is used to produce continuous alternating current (AC). The embedded system controls the whole process. Connections are made for the designed working condition. Initially high frequency charge controller is wired with doubly fed induction generator for power generation. Input power is given by rack and pinion due to small vibration of vehicle suspension. Suspension is the system used to allow relative motion between road and vehicle tires. And act as a weight transfer. This suspension gets small range of deflection rate from moving vehicle vibration. And this vibration makes spring system to gradual movement dependently with rack and pinion movement. Total jacking force of suspension system is converted to rack and pinion movement.

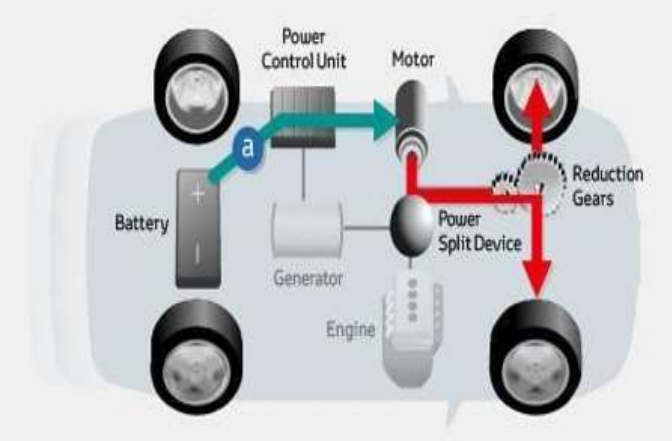


This linear force is converted into rotary movement because of pinion mechanism. After this undamming rotary force directly applied to generator through pinion movement.Generator gets powered then it rotates mechanically to produce power. Power producing is concerned only with rack and pinion not with vehicle movement. Leveling suspension is continuously working among with deflection of vehicle movement.so the power output is very precious with small input. The working principle of the electromagnetic energy-regenerative suspension is to replace traditional shock absorbers with electromagnetic actuators when vehicles start to vibrate due to uneven pavement. The motor coil cuts the magnetic induction line and outputs the voltage to the outside. The energy generated by the mechanical vibration is converted into

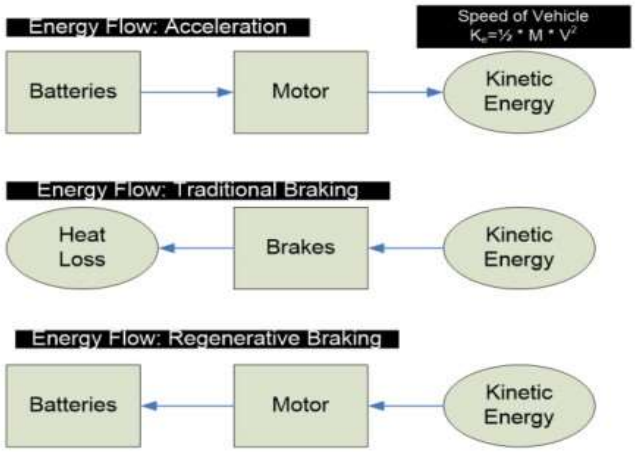
electrical energy and stored in energy storage devices, the electromagnetic energy regenerative suspension.

6.2 Regenerative Braking System:

A moving car has a lot of kinetic energy. When you apply the brakes, that energy of motion is transformed into something else, and the car slows down. Most cars use friction brakes, which inhibit motion by converting kinetic energy to heat. When brakes are applied, a lot of energy, which could be arrested and utilized for various activities, is wasted in the form of heat and also this heat damages thebrakes. Braking is the process of using a Mechanical or Electrical equipment called 'Brake' to reduce the speed of any moving or rotating equipment, like vehicles, locomotives. Every time you step on your car's brakes, you're wasting energy. That energy, which could have been used to do work, is essentially wasted.



The electric vehicle is driven by the battery. On switching the car the motor takes current from the battery. The motor converts the electrical energy into the mechanical rotation and hence the vehicle moves forward when the car starts running then generation takes place. The synchronous generator attached to the wheels starts generation. Here synchronous generator has been used because it can operate at low power. When the driving speed of the car increases, then generation also increases. Hence the generation depends upon the driving condition. The output of the generator is the Alternating type.



Hence it can be converted into DC with the help of rectifier circuit. The rectifier circuit converts this Alternating current into pulsating DC. The pulsating DC component is passed through the filter circuit which removes harmonics. Then the DC is stored in the ultra-capacitor. Hence the power can be generated without any external forces and this process is called self-generation.

7. CONCLUSION:

Regenerative braking is a small, yet very important, step toward our eventual independence from fossil fuels. These kinds of brakes allow batteries to be used for longer periods of time without the need to be plugged into an external charger. These types of brakes also extend the driving range of fully electric vehicles. In fact, this technology has already helped bring us cars like the Tesla Roadster, which runs

entirely on battery power. As designers and engineers perfect regenerative braking systems, they will become more and more common. All vehicles in motion can benefit from utilizing regeneration to recapture energy that would otherwise be lost.

Vehicle Suspension Energy Generation is very efficient and useful in converting the Kinetic Energy from the movement of the vehicle, especially the suspension, which usually goes waste, to electric energy that can be used to fulfill needs of the auxiliaries in the vehicle. Currently the batteries of automobiles are charged by specific alternator which is attached to IC engine shaft. So that the fuel used in automobiles is also consumed for rotating the alternator to charge the battery, this consumption is found to be 4% of total consumption. By newly designed suspension, regeneration system presently using alternator is detached from the engine and attached to the suspension system. The advantage of this concept is energy storage system is possible using "BESS system" and even fully drained battery is charged by ultra-capacitor using high frequency charge controller system.

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