Power Generation Through Vehicle Suspension and Regenerative Braking System in EV's

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Abstract - The given paper concentrate on regenerative suspension system which has the following aims: is to convert mechanical vibration energy (or kinetic energy achieved from the jerks or bump from road surface) with help of rack and pinion arrangement into electrical energy. Most brakes commonly use friction between two surfaces pressed together to convert the kinetic energy of the moving object into heat, though other methods of energy conversion may be employed as all the energy here is being distributed in the form of heat. Regenerative braking converts much of the energy to electrical energy, which may be stored for later use. Driving an automobile involves many braking events, due to which high amount of energy losses will generated, with greater potential savings. With buses, taxis, delivery vans and so on there is even more potential for economy. As we know that the regenerative braking, the efficiency is improved as it results in an increase in energy output for a given energy input to a vehicle. The amount of work done by the engine of the vehicle is reduced, in turn reducing the amount of energy required to drive the vehicle. The objective of our paper is to study this new type of braking system that can be collect the car's kinetic energy and convert it into electrical energy or mechanical energy. We are also going to make a working model of regenerative braking and suspension which can convert one energy from to another energy form. Regenerative braking converts total kinetic energy of vehicle wheel into mechanical or electrical energy.

Key Words: Power generation, suspension system, rack and pinion mechanism, regenerative breaking system.

1.INTRODUCTION

Power generation through vehicle suspension and regenerative braking is an innovative concept aimed at harnessing energy from the movement and braking of vehicles. It involves the integration of special technologies and systems that can convert the kinetic energy produced during vehicle suspension movement and braking into usable electrical energy. Traditionally, vehicles have relied solely on fossil fuels to generate power and propel themselves. However, with growing concerns about environmental sustainability and the need to reduce carbon emissions, alternative methods of power generation have gained prominence. Power generation through vehicle suspension and regenerative braking is one such solution that offers potential energy savings and increased efficiency.

When a vehicle is in motion, its suspension system is subjected to constant vertical movement due to bumps, uneven road surfaces, and other disturbances. This movement causes kinetic energy to be generated, which is typically wasted as heat through conventional shock absorbers. However, by implementing energy harvesting systems, this kinetic energy can be captured and converted into electrical energy. Regenerative braking is another crucial aspect of this concept. When a vehicle decelerates or comes to a stop, conventional braking systems dissipate the kinetic energy as heat, resulting in energy wastage. Regenerative braking technology allows the vehicle's kinetic energy to be captured and stored as electrical energy, which can then be used to power various vehicle components or stored in batteries for future use.

By utilizing both suspension and regenerative braking systems, vehicles have the potential to generate significant amounts of electrical energy during their operation. This energy can be used to power auxiliary systems, reduce reliance on the vehicle's main power source, or even be fed back into the grid. Implementing power generation through vehicle suspension and regenerative braking has several potential benefits. It can increase overall vehicle efficiency, reduce fuel consumption, and lower emissions. Furthermore, it offers the possibility of creating a more sustainable transportation system by tapping into renewable energy sources and reducing the extreme use of fossil fuels. While this concept shows promise, there are still challenges to overcome. The integration of energy harvesting systems into vehicle suspensions and braking systems requires careful engineering and consideration of safety, reliability, and cost factors. Additionally, the captured electrical energy needs to be efficiently stored and managed to ensure optimal usage and longevity.

2. LITERATURE SURVEY

While working on this paper we do firstly some literature view and this literature view provides an overview of the key concepts, research findings, and future prospects related to this topic.

1. Introduction to Power Generation in Vehicle Suspension and Regenerative Braking:

Electric vehicles utilize regenerative braking systems to convert the kinetic energy generated during braking into electrical energy, which is then stored in the vehicle's battery for later use. Power generation through vehicle suspension involves the use of various mechanisms to convert the vertical motion of the suspension system into electrical energy.

2. Potential Benefits and Challenges:

Power generation through regenerative braking and suspension has the potential to increase the overall energy efficiency of electric vehicles and extend their driving range. However, there are challenges associated with the implementation of these technologies, such as the added weight and complexity of the systems, cost considerations, and the need for efficient energy conversion mechanisms.

3. Regenerative Braking Systems:

Numerous studies have focused on improving regenerative braking systems in EVs to enhance energy recovery efficiency. Different control strategies, such as optimal energy management algorithms and predictive control methods, have been explored to maximize energy capture during braking events. Research also investigates the impact of factors like vehicle speed, battery state of charge, and road conditions on the performance of regenerative braking systems.

4. Power Generation from Suspension:

Various mechanisms have been proposed to generate power from vehicle suspension, including electromagnetic, piezoelectric, and hydraulic systems. Electromagnetic systems use the relative motion between magnets and coils to induce electrical current, while piezoelectric systems rely on the deformation of piezoelectric materials. Hydraulic systems utilize the motion of hydraulic fluids to drive generators and produce electricity.

5. Research Findings and Experimental Studies:

Experimental studies have demonstrated the feasibility of power generation through regenerative braking and suspension systems in electric vehicles. Researchers have explored different design configurations, materials, and control strategies to optimize the energy conversion process and improve overall system performance. Studies have also investigated the impact of various factors, such as vehicle speed, road conditions, and suspension characteristics, on the amount of power that can be generated.

6. Future Prospects and Potential Applications:

Further advancements in materials science, energy conversion technologies, and control systems are expected to enhance the efficiency and viability of power generation through vehicle suspension and regenerative braking. The integration of these systems into electric vehicles could help increase their driving range, reduce reliance on external charging infrastructure, and improve overall energy sustainability. The development of standardized testing methods and regulations specific to power generation through suspension and regenerative braking would be crucial for wider adoption and commercialization of these technologies.

In conclusion, the literature on power generation through vehicle suspension and regenerative braking in electric vehicles highlights the potential benefits, challenges, and research findings associated with these technologies. Further research and development efforts are needed to optimize system efficiency, reduce costs, and ensure the seamless integration of these technologies into electric vehicles of the future.

3. METHODOLOGY

So in the view of research methodology of current research objective will be outlined as shown in the flowchart below.

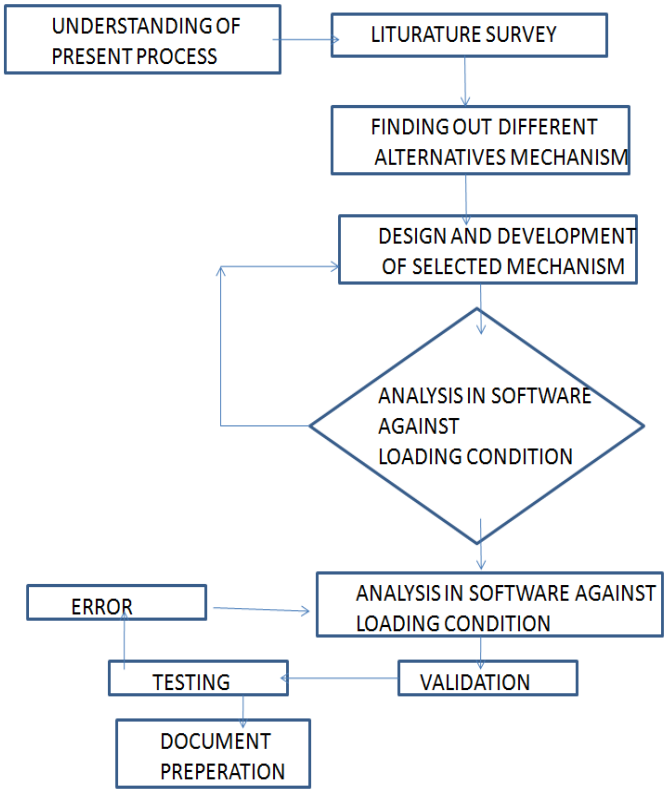

Fig 1: System design flow

4. WORKING PRINCIPA

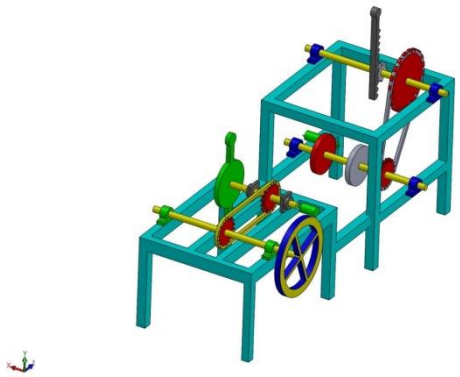

Fig 2: working model

This paper is about conversion of the force energy into electrical energy. By means of drive mechanism such as rack and pinion, spur gear and spring assembly. DC generator is the device which converts rotary motion of gear shaft into the electrical energy.

The working principle is simple. When a load comes on top plate of the device, the plate will dip down slightly due to the weight of the vehicle. The downward movement of the plate results in rotation of the pinion gear which is engaged with rack. As the shaft of pinion gear starts rotating the spur gear mounted on that shaft also rotates. The pinion gear which is engaged with spur gear starts rotating. The pinion gear is mounted on second shaft on that shaft another spur gear is mounted. This spur gear is connected to the shaft of dc generator by means of belt drive. As the generator shaft starts rotating the electric pulses are created and they are shown on the electric board. The top plate reverts back to its original position due to negating springs provided in the device.

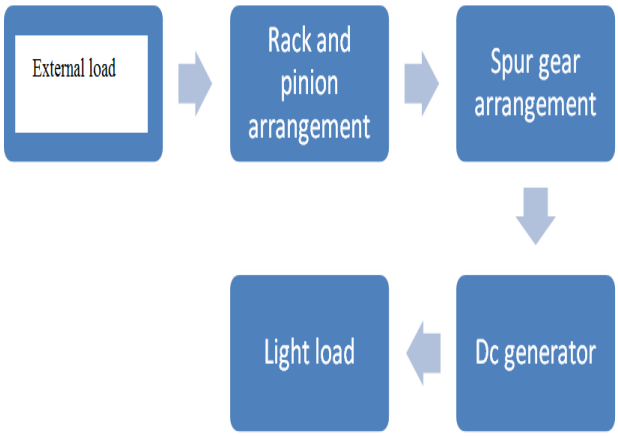

Fig 3: *System design flow*

The above figure shows the system design flow. As shown in figure the foot step platform arrangement which is connected with rack and pinion arrangement. Rack and pinion is connected with the gear arrangement. Further the gear arrangement is connected to the dc generator with the help of belt. Then dc generator is connected to the light load.

5. COMPONENT

5.1 Rack and Pinion

Fig 4: Rack and Pinion

Rack and pinion is a simple mechanism used to convert rotational motion into linear motion. It consists of two main components: a gear-like toothed bar called the rack and a circular gear called the pinion. The rack has teeth running along its length, while the pinion has teeth on its circumference. When the pinion gear rotates, its teeth engage with the teeth on the rack, causing the rack to move in a linear direction. The direction and distance of the rack's movement depend on the direction and magnitude of the rotation of the pinion. Rack and pinion systems are commonly used in various applications, such as steering systems in cars, where they help convert the rotational motion of the steering wheel into linear motion to turn the wheels. They are also used in machinery, robotics, and other mechanical systems that require precise linear motion control.

5.2 DC GENERATOR

Fig 5: DC Generator

A DC generator, also known as a dynamo or generator, is a device that converts mechanical energy into electrical energy. It uses electromagnetic principles to produce a direct current (DC) output. The basic components of a DC generator include a stationary part called the stator and a rotating part called the rotor. The stator consists of a coil of wire that is connected to an external circuit, while the rotor consists of a magnet or a set of magnets. The rotor is mounted on a shaft, which can be turned manually or by an external source of mechanical energy. When the rotor rotates, the magnetic field produced by the magnets cuts across the coil of wire in the stator. According to Faraday's law of electromagnetic induction, this movement of the magnetic field induces an electric current in the wire coil. This current flows through the external circuit, generating electrical power.

5.3 SPRING

Fig 6: Spring

A spring is a flexible and elastic object that can stretch or compress and then return to its original shape when the force acting on it is removed. It is commonly made of metal, such as steel, and is often coiled into a spiral shape. In vehicles, springs are commonly used for suspension systems to provide a smooth and controlled ride. The suspension system helps absorb shocks from bumps in the road and keeps the vehicle stable. In the context of vehicle suspension, springs are typically coil springs or leaf springs. Coil springs are made of a helical or spiral-shaped wire, while leaf springs consist of multiple layers or leaves of spring steel attached together.

5.4 SPUR GEAR

Fig 7: Spur gear

In some advanced suspension systems, particularly in hybrid or electric vehicles, spur gears can be incorporated to convert the vertical motion of the suspension into rotational motion. This is achieved by attaching a spur gear mechanism to the suspension components. As the vehicle encounters bumps or uneven surfaces, the vertical motion of the suspension is translated into rotational motion by the spur gears. This rotational motion can then be harnessed to generate electrical power using a generator or an alternator, which can be used to charge the vehicle's battery or power other electrical systems.

Spur gears can play a role in regenerative breaking system by connecting the wheels or axles of the vehicle to an electric generator. As the vehicle slows down, the wheels drive the spur gears, which, in turn, drive the generator. The generator converts the mechanical energy into electrical energy, which is then stored in the vehicle's battery for later use or used to power the vehicle's electrical systems.

6. RESULT

Output Power generated is equal to 0.57watts this power is to be transmitted. However, this much power produced, it cannot be tapped fully. From the above Purpose we have select to generate electricity by permanent magnet type D.C generator and store it by 9V lead-acid battery cell.

7. MERITS AND DEMERITS

7.1 Merits

1. Power is generated by running vehicles
2. No need of fuel to operate mechanism or input
3. Non-Conventional System
4. Generated power is stored in battery

7.2 Demerits

1. Moving part (mechanical) is high
2. Initial cost is high
3. Rust may occur on the steel bodies

8. CONCLUSION

This paper is made with preplanning, that it provides flexibility in operation. Smoother and noiseless operation by the medium of “electricity generation through regenerative braking system and suspension system”. This innovation has made the more desirable. The power generated by proposed mechanism is very low but we can increase it by using amplifier and also the DC power we can use for many application.

This paper is designed with the hope that it is very much economical and help full to many industries and workshops. This project has also reduced the cost involved in the concern paper has been designed to perform the entire requirement task which has also been provided. Thus we have completed the paper successfully.

9. ACKNOWLEDGEMENT

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