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Regenerative Suspension System for Hybrid Vehicles

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ABSTRACT: This project and implementation have attempted to use the vehicle's shockers to produce electricity. A "regenerative shock absorber" transforms unwanted linear motion and vibration into beneficial electricity, which can be directed to the power train of an electric or hybrid vehicle to lengthen the battery life. Additionally, accessories like air conditioning can be powered by electricity in non-electric automobiles. This study examined the effectiveness of converting that energy into electrical power with the use of specially created regenerative electromagnetic shock absorbers, and some of the findings are presented in this publication. The study's optimistic findings indicate that a sizeable portion of the vertical motion energy may be recovered and stored.

I. INTRODUCTION

One of the main sources of greenhouse gas emissions nowadays that contribute to global warming is motor vehicles. Only 10% to 20% of the energy from fuel combustion is utilized for vehicle movement, which accounts for 70% of all fuel sources used in transportation.

Where does the 80–90% of energy released during fuel burning go? 74% of the energy lost during fuel combustion is lost as heat energy, while the remaining 10% is lost trying to overcome friction in the drive train, aerodynamic drag, braking, and vehicle suspension. Therefore, the automotive industry is being driven to increase vehicle energy efficiency and decrease pollutant emissions by legislative regulations and environmental awareness organizations.

II. PROBLEM STATEMENT

There is a lot of research being done now on novel ways to get energy without relying on the rapidly depleting petroleum resources. Non-sustainable energy sources fail for a variety of reasons, but the strategy is less effective because of this. Many studies are being done today to find new ways to get energy without using petroleum resources. This project will present a fresh approach to getting energy from a vehicle's suspension system. This novel technique for getting energy from a suspension system for land vehicles is what we refer to as an "energy regenerative suspension system". Every car has a suspension system installed, and as the car is driving, the movement of the suspension system will produce energy, which may then be transformed into energy for other uses, like electricity. As a substitute, electricity will be produced utilizing a technology that regenerates energy from the suspension system using electromagnetic induction. The suspension system produced electricity that was used for several smaller devices, including lights and automobile radios.

III. RESEARCH GAP

We, a group of young engineers, discovered that more explorations are urgently required to help non-conventional energy get widespread acceptance. This is also crucial to protect traditional energy sources and investigate workable alternatives like solar, wind, and biomass that can promote sustainable development. Sustainable energy is energy that we are already using but are suddenly wasting for the safety of other uses. Additionally, these substitutes are simple to replenish and friendly to the environment. To fully utilize them, an energy matrix mix that is functionally efficient must be used. An engineer's attention is constantly on the difficulties of putting conceptions and ideas into practice. Therefore, for efficient product manufacture, advanced machinery, and cutting-edge procedures must continually be

created and applied. At the same time, we must ensure that accuracy and quality have not been compromised. In the age of automation, machines have assimilated with humanity. Utilizing automation equipment demonstrates that it produces at a higher pace than manual labor. In a market where there is fierce rivalry, everyone wants to boost productivity and make their equipment versatile. Technology should be adapted and put to use straight away to get a head start, be aware of the obstacles to renewable technology applications, and combine them with the T&D networks and current, conventional power generation technology. It is well-recognized that wind energy will be the most economical renewable resource in the future. However, it is unlikely that any one technology would take center stage. As a result, we decided on a kinetic generator, which is defined as "Energy in motion when it is suddenly applied with a kind of obstacle," because, by Newton's law, every action has a corresponding and opposing response. The primary justification for choosing this project work is the utilization of this reaction.

IV. OBJECTIVES

The goal is to analyze the design and test a linear electromagnetic regenerative suspension system that will harvest energy without impacting dynamic properties like ride comfort or road handling.

- To learn the fundamentals of the various Regenerative suspension systems kinds and comprehend how they work.
- To create a working prototype of a new hybrid regenerative suspension system.
- To verify theoretical findings with experimental findings by putting a regenerative shock absorber through its paces.
- To assess the viability of using the results with another type of conventional suspension system for commercial vehicles

V. SCOPE

1. Energy recovery: A regenerative suspension system might transform the kinetic energy produced by a vehicle's suspension into electrical energy, which could then be stored in a battery and utilized to power an electric motor. As a result, the petrol engine of the car would need to produce less energy, improving fuel efficiency and lowering pollutants.
2. Smooth ride: By lowering vibration and enhancing damping, regenerative suspension systems may enhance the ride quality of hybrid cars. Passengers might experience a more comfortable trip as a result.
3. Lessening wear and tear: Over time, conventional suspension systems can sustain significant wear and tear, which raises maintenance expenses. A regenerative suspension system may help the vehicle's suspension parts last longer and require less maintenance by reducing wear and tear on those parts.
4. Better handling: By giving the vehicle's suspension more exact control, regenerative suspension systems may help hybrid vehicles handle better. This might increase stability and lower the likelihood of accidents.
5. The possibility of weight savings: Regenerative suspension systems may be lighter than traditional suspension systems, resulting in lighter vehicles with better fuel economy.

VI. EXPERIMENTAL SETUP AND WORK

The experimental setup includes a hybrid vehicle chassis with a regenerative suspension system, sensors, actuators, energy storage systems, power electronics, and control algorithms. Additionally, a data-gathering system should be installed to capture and record all pertinent parameters during the experimental tests. The suspension system should have the proper equipment, such as accelerometers, displacement sensors, strain gauges, load cells, and electrical meters. Power management and control should be implemented to maximize energy harvesting and utilization. Control algorithms may need to be developed to govern the energy flow between the suspension system, hybrid powertrain, and energy storage units.

The planned experimental work involves baseline testing on a hybrid vehicle using the stock suspension system, and integration of the regenerative suspension system into the hybrid vehicle platform with sensors, actuators, and power electronics installed and calibrated correctly. Performance Assessment tests are conducted to gauge how well the regenerative suspension technology is working. These tests include measuring the quantity of electrical energy produced by the regenerative suspension system, analyzing how mechanical vibrations are converted to electrical power, and examining the ride quality, stability, and handling characteristics of the vehicle. Power Management and Control tests are also conducted to optimize energy flow and utilization between the hybrid drivetrain, energy storage units, and the regenerative suspension system. Data Analysis, Optimization, and Iteration, Validation & Verification are all important steps to improve the regenerative suspension system's performance and energy-harvesting capacities.

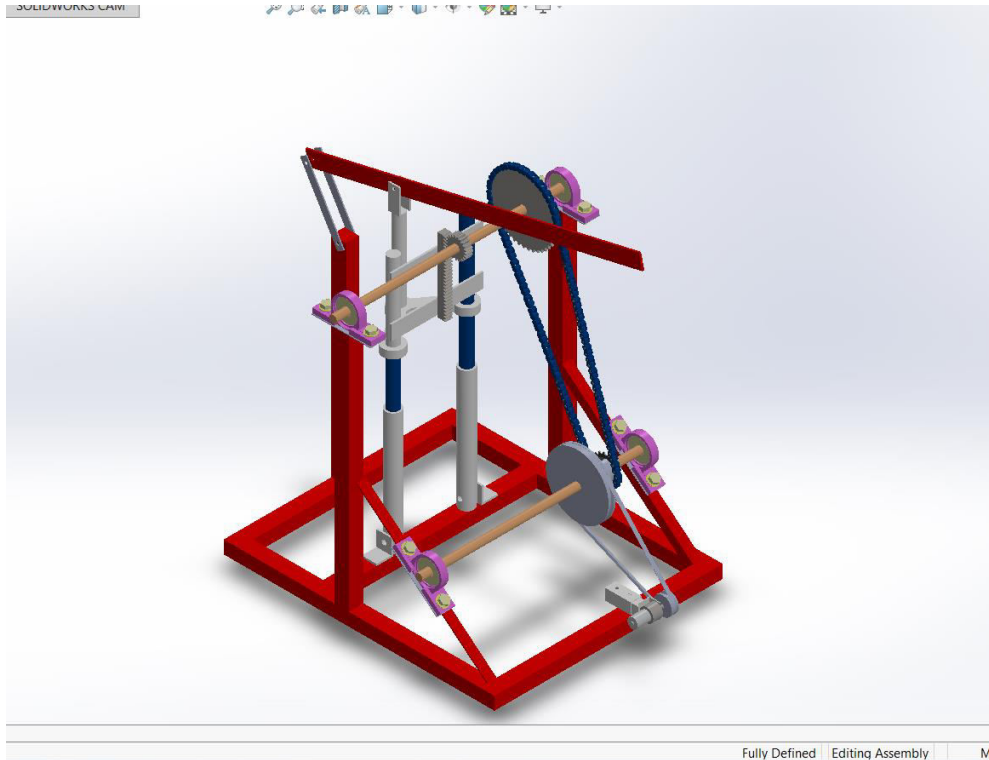


Fig. a) CAD Design of Regenerative Suspension System for Hybrid Vehicles

VII. CONCLUSION

Heat energy is lost as a result of the vibration energy of the suspension system of the vehicle.

The fuel consumption is slightly reduced when a regenerative suspension system is used since wasted energy is turned into useful energy like electrical energy. using the

Oscillation guide capacity, regenerative effectiveness, and application reliability all look to be at maximum performance. Regenerative systems can become crucial in the automobile manufacturing business by utilizing cutting-edge technologies. Electricity is generated using regenerative systems.

VIII. CONCLUDING REMARKS AND FUTURE SCOPE

This paper focuses on suspension system energy-saving methods, which can be useful in India, which has both good and bad roads and geographical regions. The paper shows that the project model has the potential to be adopted across a variety of electric motors, with the cost of the device being kept low. It is a worthwhile undertaking for India. The design and analysis of a regenerative shock absorber system use hydraulic and mechanical transmissions to transform linear motion into rotary motion to produce electricity. It can be concluded that different dampers can be designed for different frequencies of operations.

Future development could result in the following:

- To create a working prototype of the regenerative shock absorber and quantify the electricity generated.
- To run experimental auxiliary systems using the power thusly generated.
- To create a shock absorber that can generate electricity both during and after its stroke.



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