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A Review on Regenerative Electromagnetic Suspension System

Sanket Bansode, Aniket Shirgupe, Yuvraj Gondil, Utkarsh Taware
Mechanical Engineering, SKN sinhgad Institute of technology and Science, lonavala, Maharashtra, India

ABSTRACT

Now a days, automobile industries and machinery parts uses incompressible fluid as a shock absorber in order to absorb sudden shock and vibrations during motion. The moto of provide these absorbers to reduce damping effect by converting kinetic energy of sudden shock in heat energy and then dissipated. Our aim to replace this shock absorber by electromagnets using concept of polarity. In this study, an electromagnetic regenerative shock absorber is analysed. The device is capable of converting the vibrational energy, usually wasted as heat in conventional dampers, into electrical energy. This converted energy then stored in battery for the further use. This system can be used for increase the comfort of travelling and is helpful for hybrid cars too.

Keywords: Renewable Energy, Electromagnets, Dissipated Heat

I. INTRODUCTION

The main purpose of the project is to utilise the kinematic energy wasted from suspension system for energy generation. For that purpose, we are replacing normal shock absorbing system with electromagnetic regenerative suspension system.

Actual function of suspension system is to absorbs the vibrations and its supports the vehicle weight and which gives passengers comfort and improves riding qualities of vehicles by minimizing the damages to the vehicle components.

Basic components of conventional suspension system are spring and damper. Due to road excitations vibrations are transferred in the vehicle those vibrations are absorbed by damper using principle of heat dissipation's, that dissipated heat is in the form of energy but in conventional suspension system that heat get wasted We can use this wasted energy as renewable energy. Now days renewable energy is the need in today's energy scenario. Dissipated heat can be used to increase fuel efficiency of the vehicle by converting kinetic energy of shock absorber to electrical energy and it also can be stored for further applications, which is beneficial for electrical appliances in the vehicle and to improve the overall efficiency.

1] Energy Dissipation

All form of energies is the source of power for the conducting various types of applications. but in conventional suspension system this energy gets wasted in order to utilise this energy as a source of energy for generation of dissipated heat some factors should be considered and those are vehicle speed, road roughness, suspension stiffness and damping coefficient for conventional suspension system.

2] Energy Regeneration

It is important that how much amount of energy we are producing by using this technique because it defines is our system capable for handling heavy vibrations. Also, it is important that this technique will increase the fuel efficiency of vehicle. By

implementing shock absorber 10 % of energy can be recovered.

3] Configuration of Regeneration Suspension System

Two main types of regeneration system – mechanical and electromagnetic

a. **Mechanical regeneration system: -**
   In the mechanical regeneration system traditional system is being used like hydraulic and pneumatic system. Accumulator is used to store the energy. it absorbs the vibrational energy and convert it into potential energy. This system has some disadvantages like for hydraulic pipeline it takes lots of space also its complex to design, small leakage in pipe may spoiled whole system.

b. **Electromagnetic regeneration System: -**
   To overcome the limitations of mechanical system Traditional suspension system can be replaced by Electromagnetic regeneration System because of its advantages over traditional system. it absorbs energy from shock and vibrations moreover stores and reuse it. it has high performance and increases efficiency.

II. LITERATURE SURVEY

Energy absorbed by the vibration is get wasted but power generation by shock absorber bring new hope for recycling and reuse the energy. If we improve the technology it will become the new trend in automobile industry. [1]

The conversion of kinetic energy from suspension is very efficient and useful also it can be fulfilling the need for the auxiliaries in vehicle. If we install electromagnetic regeneration system for all 4 wheels then we can generate high amount of electric power. This amount of electric power can be stored and further used for the working of vehicle air conditioner or electrical appliances of vehicles. This suspension system will be mostly useful for heavy compressed vehicles, fire brigade trucks, milk trucks. [9]

III. METHODS AND MATERIAL

1] Components:

1.1 Spring:

Spring is used to store the mechanical energy. Material for spring is oil hardened and tempered spring steel wire.

Figure 1. Spring

Table 1. Specifications of Spring

Parameters	Values
Spring Displacement	85.26 mm
Spring Rate	33.36 N/mm
Wire Diameter	9 mm
Coil Mean Diameter	100 mm
Number of coils	2 actives + 2 inactive
Solid length	36 mm
Free length	127.26 mm

1.2 Shock absorber:

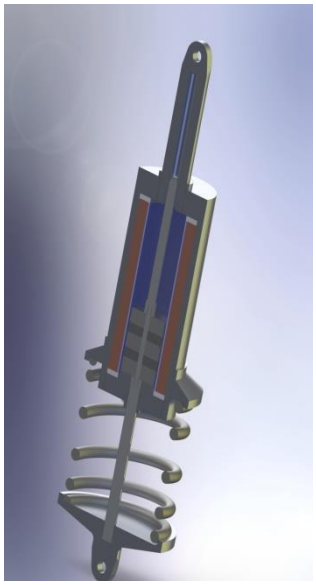

Figure 2. Cad model of Cross section of Electromagnetic Shock Absorber

Figure 3. Actual electromagnetic Shock Absorber

Material:

Material used for this shock absorber are Aluminum 6061 And stainless steel

1.3 Magnet:

Figure 4. Set of Magnet and iron core

We used N45 neodymium Magnets.

1.4 Copper Coil:

Figure 5. Copper coil

Gauge size = 18awg

Normal wire diameter =0.0403

Ohms/mgt normal =6.386

5.Battery:

Figure 6. Battery

2] Working Principle:

2.1 Electromagnets:

An electromagnet is a type of magnet in which the magnetic field is produced by an electric current. The magnetic field disappears when the current is turned off. Electromagnets usually consist of wire wound into a coil. A current through the wire creates a magnetic field which is concentrated in the hole in the centre of the coil. The wire turns are often wound around a magnetic core made from a ferromagnetic or ferrimagnetic material such as iron; the magnetic core concentrates the magnetic flux and makes a more powerful magnet. The main advantage of an electromagnet over a permanent magnet is that the magnetic field can be quickly changed by controlling the amount of electric current in the winding. However, unlike a permanent magnet that needs no power, an electromagnet requires a continuous supply of current to maintain the magnetic field.

2.2 Faraday's Law:

Any change in the magnetic environment of a coil of wire will cause a voltage (emf) to be "induced" in the coil. No matter how the change is produced, the voltage will be generated. The change could be produced by changing the magnetic field strength, moving a magnet toward or away from the coil, moving the coil into or out of the magnetic field, rotating the coil relative to the magnet

$$\text{EMF} = -N\frac{\Delta\emptyset}{\Delta t}$$

2.3 Lens Law:

When an emf is generated by a change in magnetic flux according to Faraday's Law, the polarity of the induced emf is such that it produces a current whose magnetic field opposes the change which produces it. The induced magnetic field inside any loop of wire always acts to keep the magnetic flux in the loop constant. In the examples below, if the B field is increasing, the induced field acts in opposition to it. If it is decreasing, the induced field acts in the direction of the applied field to try to keep it constant.

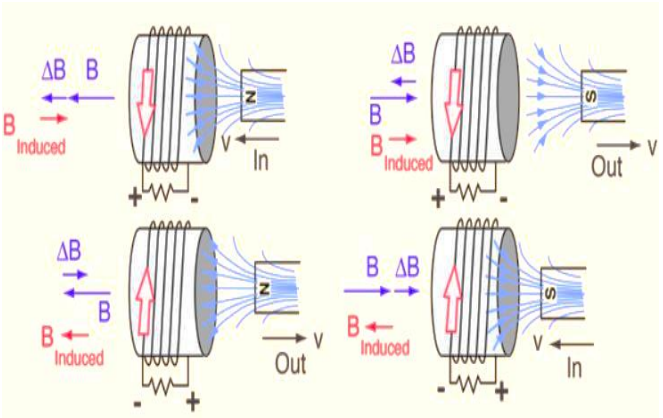

Figure 7. lens law

2.4 Block Diagram

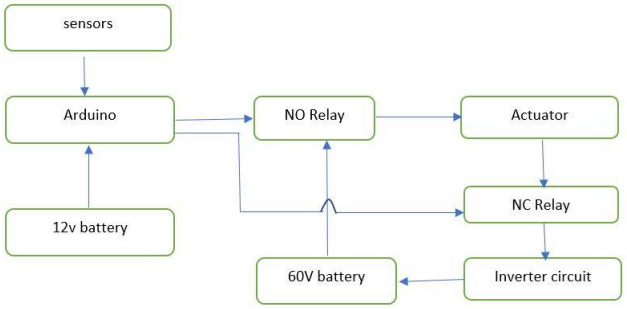

Figure 8. Block Diagram

2.5 Working Process

1. As the vibrations occurred spring get compressed.
2. Because of fixed and moving magnet emf is generated in coil
3. The generated voltage is stored in battery.

IV. CONCLUSION AND FUTURE SCOPE

This review paper is all about discussion and development of energy regeneration opportunities in suspension system. While studying, we focused on how to reuse the dissipated heat to create green energy also we designed a regenerative electromagnetic suspension system whose fuel efficiency of vehicle is more traditional suspension system. This system can be implemented in 4-wheeler vehicle by using this we can regenerate high amount of electrical power which further can be used for Air conditioning and other electric appliances of vehicles

For heavy vehicle's it gives more energy generation so it can be seen in vehicle's like Truck, containers in upcoming years and also it can be used in hybrid vehicles to increase their performance and efficiency of vehicles.

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