

Design and Fabrication Of Electricity Generating Shock Absorber

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ABSTRACT

Road vehicles can expand a sign amount of energy in undesirable vertical motions that are induced by road bumps, and much of that is dissipated in conventional shock absorbers as they dampen the vertical motions. An electromagnetic linear generator and regenerative electromagnetic shock absorber is disclosed which converts variable frequency, repetitive intermittent linear displacement motion to useful electrical power.

As a regenerative shock absorber, the disclosed device is capable of converting parasitic displacement motion and vibrations encountered under normal urban driving conditions to a useful electrical energy for powering vehicles and accessories or charging batteries in electric and fossil fuel powered vehicles. The disclosed device is capable of high power generation capacity and energy conversion efficiency with minimal weight penalty for improved fuel efficiency.

Keyword : - Shock Absorber1 , Regenerative2, Power Generation3 etc...

1.INTRODUCTION

A shock absorber is a mechanical device designed to smooth out or damp sudden shock impulse and dissipate kinetic energy. It is analogous to a resistor in an electrical circuit. One design consideration, when designing or choosing a shock absorber is where that energy will go. In most dashpots, energy is converted to heat inside the viscous fluid. In hydraulic cylinders, the hydraulic fluid will heat up. In air cylinders, the hot air is usually exhausted to the atmosphere. In other types of dashpots, the dissipated energy can be stored and used later. Shock absorber are an important part of automobile and motorcycle suspensions, aircraft landing gear, and the supports for many industrial machines..

They may be mechanical (e.g. elastomeric or coil spring) or rely on a fluid (gas, air, hydraulic), which absorbs shock by allowing controlled flow from outer to inner chamber of a cylinder during piston actuation. In conventional shock absorbers the piston rod is typically returned to the unloaded position with a spring.

2. LITERATURE SURVEY

1. A Reaserch paper by - M. Sutharsan, Malli Sudheer, L. Arun Kuma "Power Generation Using Magnetic Shock Absorber"

This paper presents design and finite element analysis of an electromagnetic energy regenerative shock absorber which can efficiently recover the vibration energy wasted in vehicle suspension system. In this paper, design process of electromagnetic energy regenerative shock absorber is explained with due consideration to space limitations in commercial vehicle

2. A Reaserch paper by - Purushothaman G., Divyaa V.G., Veena Kannan, Subiksha M., Balamurugan M "REGENERATIVE SUSPENSION"

This paper deals with a valuable amount of kinetic energy remain unutilized in vehicle suspension systems. The vehicle can be made more energy efficient by actualizing a regenerative mechanism that works to

render useful the unutilized kinetic energy in the suspension system.

3. A Research paper by -Dr. Seema Tiwari “Regenerative Shock Absorber: Research Review”

This paper audits the current research on the regenerative shock absorbers. It initially examines about the energy dispersal from the vehicles and afterward the capability of recoupling this scattered energy utilizing a regenerative shock absorber. It additionally audits the different innovative work done on the regenerative shock absorber

4. A Research paper by - Zhanwen Wang “A high-efficiency regenerative shock absorber considering twin ball screws transmissions for application in range-extended electric vehicles”

In this paper, a high-efficiency regenerative shock absorber considering twin ball screws transmissions is proposed for application in range-extended electric vehicles. The proposed regenerative shock absorber can convert vibrational kinetic energy, which is traditionally dissipated as heat in suspension systems, into electricity

5. A Research paper by - Ganesh Kadam & Omkar Bochar “Regenerative Shock Absorber”

In this paper, protection of the environment and reduce vehicle emissions and fuel consumption of vehicles, it is necessary to recover the energy wastage by car, such as braking energy engine exhaust emission energy and vibration energy of suspension etc. Usually the vibrational energy caused by road roughness when car runs has not been paid attention to and it is wasted through conversion to thermal energy. If the vibrational energy is recovered and it is converted into the other form of energy such as electric or hydraulic power to supply for other devices, then the aim of ecofriendly energy saving is reached. In this project the vibrational energy was converted into electrical energy through the innovative shock absorbers, which rectifies the linear shock absorber motion and converts kinetic energy into electrical energy by using generator

3.OBJECTIVES

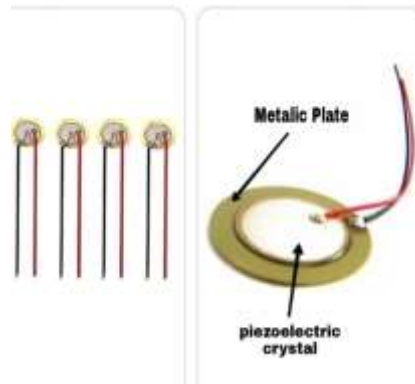
The main aim of the project is efficiently transforming that energy into electrical power by using optimally designed power generating shock absorber. In turn, the electrical power can be used to recharge batteries or others efficient energy storage device rather than be dissipated.

4.COMPONENT USED

A. Conventional Shock Absorber:



B. Piezoelectric Transducer



- The Piezoelectric Crystal is one of a small scale energy resource .
- When a Mechanical Stress is Applied on this crystal it generates a little amount of electricity which is known as Piezoelectricity.
- In this Project we are generating voltage with the help of Piezoelectric Transducer

C.Foam



D.Connecting Wires



E. Digital Multimeter



5. WORKING PRINCIPLE

Piezoelectric Transducer works with the principle of piezoelectricity .The faces of Piezoelectric material , usual quartz,is coated with a thin layer of conducting material such as silver .When stress has applied the ions in the material move towards one of the conducting surface while moving away from the other . This results in the generation of electricity

5.1 WORKING

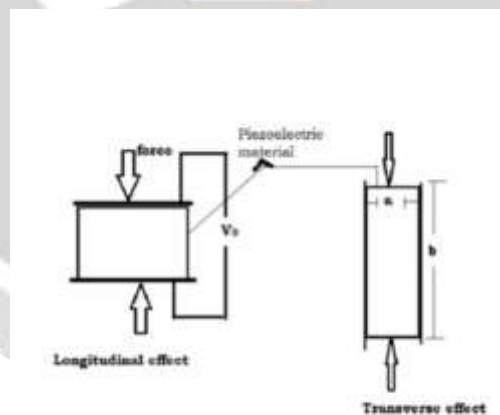


Fig : Working Principle of Piezoelectric Transducer

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Whenever the vehicle experience a jerk , the suspension moves down. The piezoelectric transducers attached to the shock absorber also experienced a force As the piezo sensors experiences the force it generates electricity

The electricity that is generated passes to the bridge rectifier via the connections from the Winding.The

bridge rectifier converts the Alternating Current to Direct Current. The electricity is stored for the further use.

5.2 DESIGN

Selection & design criteria

Selecting the proper design is very essential in all departments of engineering fields. General Requirements of Machine Design's are:

- Low Cost.
- Simplicity of design
- High productivity
- Good Appearance.
- Safety and convenience of control
- Shape and size and also necessary surface finish.
- Ability to produce and provide required accuracy
- More durability

5.3 DESIGN PROCEDURE

Before proceeding to the process of manufacturing, it's necessary to have some knowledge about the project design essential to design the project before starting the manufacturing. Maximum cost of producing a product is established originally by the designer. General Design procedure for a product when a new product or their elements are to be designed, a designer may proceed as follows:

- Make a detailed statement of the problems completely; it should be as clear as possible & also of the purpose for which the machine is to be designed.
- Make selection of the possible mechanism which will give the desired motion.
- Determine the forces acting on it and energy transmitted by each element of the Machine
- Select the material best suited for each element of the machine.
- Determine the allowable or design stress considering all the factors that affect the strength of the machine part.
- Identify the importance and necessary application of the machine.
- Problems with the existing requirement of the machine, productivity and demand.
- Determine the size of each element with a view to prevent undue distortion or breakage under the applied load.
- Modify the machine element or parts to agree with the past experience and judgment and to facilitate manufacture.
- Make assembly and detail drawings of machine with complete specification for the materials and manufacturing methods i.e. accuracy, surface finish etc.

- **Design of Spring:**

There are many different types of springs and spring materials. In the design calculations, the following assumptions are considered:

- a) The type and form of the spring will be the compression spring ground.
- b) The material must be chosen for the maximum energy and mass, such as music wire, ASTM A228. Chrome Vanadium or Chrome Silicon steel wire.
- c) The ends of the spring are to be closed and ground.
- d) The spring is to have maximum energy for the limited space, while the stress level is not exceed the maximum yield strength of the wire.
- e) The spring operates periodically with a long interval of rest.
- f) If the spring requires the use of material 0.5" or larger in diameter, wound hot from bar stock will be used.

The force F_s is produced by a linear elastic spring along its length x with constant K_s .

$$F_s = K_s \cdot x$$

where: x -space available when the spring is compressed

- K_s - spring constant or trial rate, which is a measure of a springs stiffness

- **DESIGN CALCULATIONS FOR HELICAL SPRINGS FOR SHOCK ARSORBERS**

Material: Steel (modulus of rigidity) (G) = 41000 N/mm²

Mean diameter of a coil (D) = 62mm

Diameter of wire (d) = 8mm

Totalnumber of coils (n1) = 18

Height (h) = 220mm

Outer diameter of spring coil (DD) = $D + d = 70\text{mm}$

No of active turns (n) = 14

Weight of bike (w) = 125 kgs

Let weight of 1 person = 75kgs

Weight of 2 persons = $75 \times 2 = 150\text{Kgs}$

Weight of bike+ Persons= 275Kgs

Rear suspension = 65%

65% of 275 = 165Kgs

Considering dynamic loads it will be double (W) = 330 Kgs = 3234 N

For single shock absorber weight = $[w/2] = 1617\text{N} = \{W\}$

Spring index (C) = 7.75 = 8

Solid length (Ls) = $n_1 \cdot d = 18 \cdot 8 = 144\text{ mm}$

Free length of spring (Lf) = solid length+ maximum compression + clearance between adjustable coils

(Lf) = $144 + 282.698 + 0.15 \cdot 282.60$

(Lf) = 469.102

Spring rate (K) = 5.719 Pitch of coil,

Stresses in helical springs (P) = 26

Maximum shear stress induced in the wire (Ts) = 499.519 N/mm^2

Values of buckling factor (Kb) = 0.05 (for hinged and spring)

The buckling factor for the hinged end and built-in end springs,

(W_{cr}) = $5.719 \times 0.05 \times 469.102 = 134.139$

6. FABRICATION

Fabrication is the building of metal structures by cutting, bending, and assembling processes. It is a value added process that involves the construction of machines and structures from various raw materials. A fabrication shop will bid on a job, usually based on the engineering drawings, and if awarded the contract will build the product. Large fabrication shops will employ a multitude of value added processes in one plant or facility including welding, cutting, forming and machining



7. ANALYSIS

No	Component	Qty	Cost
1	Conventional Shock Absorber	1	2500
2	Piezoelectric Transducers	10	300
3	Foam	10	200
4	Connecting Wires	4m	50
5	Square pipe	21 cm	50

6	Metal rod	50 cm	50
7	Digital Multimeter	1	200
8	Breadboard	1	100
9	Miscellaneous	1	1000/-
10	Labor cost		600/-
		Total cost	5500

We are comparing the electricity generation with the piezo by applying different weights on the shock up by the no of persons of diff. weights

Person	Weight	Voltage Observed
Person 1	45	1.98 V
Person 2	50	0.83 V
Person 3	55	1.76 V
Person 4	60	2.75 V

8. ADVANTAGES

1. High Efficiency ,energy saving &low operating Cost
Wide operating cost
2. Low noise and low Vibrations
3. Automatic control for charging
4. Robust and Simplified structure
5. Low failure rate and high reliability
Maximum accessibility and total Connectivity

9.DISADVANTAGES

1. In the rainy season due to the moist environment the system Efficiency lowers

10.CONCLUSION

- Energy cannot be created or destroyed, but any form of energy transform into another form.

- The Power Generating Shock Absorber (PGSA) uses energy that would lost as heat to generate electricity.

