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# DESIGN AND MANUFACTURING OF REGENERATIVE SUSPENSION SYSTEM

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**Abstract— In this paper generation of electricity with the help of the shockers used in vehicles isstudied. A regenerative shock absorber is a type of shock absorber that converts parasitic intermittent linear motion and vibration into useful energy, such as electricity. Conventional shock absorbers simply dissipate this energy. When used in an electric vehicle or hybrid electric vehicle the electricity generated by the shock absorber is diverted to its power train to increase battery life.In non-electric vehicles, the electricity is used to power accessories (air conditioning). Several different systems are developed nowadays, though they are still in stages of development and not installed on vehicles. The system is controlled by an active mechanical and electronic system that optimizes the damping, providing a smoother ride while generating electricity to recharge the batteries or operate electrical equipment. In this paper are some of the results of a study aimed at determining the effectiveness of efficiently transforming that energy into electrical power by using optimally designed regenerative electromagnetic shock absorbers. In turn, the electrical power is used to recharge batteries or other efficient energy storage devices.**

**Keywords— shock absorber, energy efficiency, flywheel, regenerative suspension**

## I.INTRODUCTION

In today's world, motor vehicles are among the primary contributors to greenhouse gas emissions, which in turn contribute to global warming. A significant portion of fuel, approximately 70%, is utilized for transportation, and a mere10 to 20% of the fuel combustion energy is used for vehicle mobility. This raises the question of where the remaining 80to 90% of fuel combustion energy is expended. A substantial 74% of this energy is wasted as heat energy, while the remaining 10% is wasted overcoming frictions like drive train frictions, aerodynamic drag fiction, braking, and vehicle suspension frictions. Consequently, legal requirements and environmental awareness agencies are encouraging the automotive industry to improve energy efficiency and reduce pollutant emissions.

The primary role of vehicle suspension is to diminish the disturbance caused by road roughness, acceleration, deceleration, and cornering to the chassis for enhanced ride comfort and maintain a good tire-ground contact force for better vehicle handling and mobility. Conventional suspension systems typically feature springs and viscous shock absorbers that dissipate vibration energy into waste heat to guarantee ride comfort and road handling. Passive dampers are preferred and widely used in most vehicles today due to their simplicity and reliability. Softer dampers offer more comfortable rides, while stiffer ones provide better stability and road handling.

### 1.1 OBJECTIVE

Objective is design analysis and testing of linear electromagnetic regenerative suspension system which will be harvesting energy without affecting dynamic characteristics such as road handling and ride comfort. To study the principles of the various types of Regenerative suspension systems and understand their functions and performances. To

perform required calculations and test the CAD model for analysing the results.To build prototype of hybrid regenerative suspension system.To store the kinetic energy using flywheel.To light up the indicator lamps attached to system as finaloutput.

### 1.2 PROBLEM STATEMENT

Nowadays, there is much research towards new methods to obtain energy without relying on petroleum resources simply diminishing day by day. Although, there are many factors that contribute to the failure of non-sustainable energy sources, the method is less efficient and so. Today's, there are many researches towards new methods to obtain energy without relying on petroleum resources. This project will introduce a new method of obtaining energy from suspension system for vehicles. We call this method as "energy regenerative suspension system" a new method of obtaining energy from suspension system for land vehicles. the suspension system is installed in a vehicle in each car and when the car is moving, there will be movement in the suspension system will then produce energy that can be converted into energy that can be used for other applications such as electricity. So as an alternative, the regenerate of energy from the suspension system using electromagnetic induction concept that will generate electricity. The electricity was generated by the suspension system to be used in smaller applications such as car radios, lights and others.

## II. LITERATURE REVIEW

Gupta et al. [1] Theoretical results show that implementing regenerative shock absorbers can recover a maximum of 10% approx. fuel efficiency from the vehicle suspension system. The aim and objective of the project are to generate electricity for the starter, headlight, and battery charging, and the paper highlights that suspension system energy regenerating can fulfill the demand of charging the battery.

Tiwari et al.[2] Overall, this research paper provides valuable insights into the potential of regenerative suspension systems to increase the energy efficiency of EVs and reduce their environmental impact.

Hussain et al.[3] This paper describes the general design and simulation of the regenerative suspension system, drive modes types of regenerative suspension system, speed bump generating electricity, MR electromagnetic regenerative damper, and the future of the regenerative suspension system.

Abdullah et al. [4] The article discusses the development and analysis of a retrofit electromagnetic energy regenerative suspension system test rig, which can be used for testing the system in a laboratory.

Lendhe et al.[5] The paper highlights that a significant amount of fuel is burned to power the air conditioning system while driving, and this can be avoided by using the compressed air produced by the suspension system.

Zang et al.[6]This paper identifies research gaps and proposes corresponding research questions for future work. Overall, the paper provides an in-depth analysis of regenerative shock absorbers and highlights their potential benefits in reducing fuel consumption and greenhouse gas emissions while improving ride and comfort performance.

## III. CONSTRUCTION

1. Frame made up of the M.S. angle plate on which the whole arrangement is to be mounted.
2. Firstly altered shock absorber on which chain is welded is fitted on the horizontal angle plate with the help of nut andbolt.
3. Shock absorber carries the handle for giving the bumps and chain which is welded on it.
4. Gear box and alternator is fitted on vertical angle plate input shaft of the gear box carries freewheel with the help ofhub.
5. Teeth of the freewheel should be engaged in the chain on the shock absorber.

## IV. WORKING

Regenerative suspension basically new concept of non-conventional energy generation. It is electromechanical energy generating machine. This machine converts reciprocating motion into rotary motion. The rotational power is stored in flywheel & flywheel rotates dynamo, which generates electricity.

Here first important point is how we get reciprocating motion, which is prime input in the system. For that we use weightof moving vehicles that run on roads. We put our mechanism on bike suspension, the head of rack with pinion. When vehicles move on speed breaker rack will be reciprocate. The rack is attached with pinion that rotates in one direction only. The rack & pinion arrangement convert reciprocating motion into rotary motion.

This rotary motion is further magnified using chain drive. The output of free wheel is attached with flywheel which storeskinetic energy and transfer to dynamo which generate electricity with zero cost. A "generator" and "motor" is essentiallythe same thing: what you call it depends on whether electricity is going into the unit or coming out of it. A generator produces electricity. In a generator, something causes the shaft and armature to spin. An electric current is generated, as

shown in the picture (lightning bolt). Lots of things can be used to make a shaft spin - a pinwheel, a crank, a bicycle, a water wheel, a diesel engine, or even a jet engine. They're of different sizes but it's the same general idea. It doesn't matterwhat's used to spin the shaft - the electricity that's produced is the same.

## V. CALCULATION

In our project load is applied by handle in prototype model is 20 kg. = 200 N, This 200N is transferred topinion gear through spur gear.

Dia of pinion gear is 60mm. So Torque generatedT = F x r

T =200 x 5

$T_1$ = 1000 N-mm

The ratio is 1:4, So torque on dynamo shaft will be 250N-mm = 0.25 N-m

Formula for power output is

$P = \frac{2\pi N T}{60}$

Where,

N→ Rpm of pinion gear = 240 rpm

T →Torque transmitted, $T_2$ = 0.25 N-m

$P = \frac{2\pi \times 360 \times 0.25}{60}$

P = 6.28 watt

So, we will buy 300 Rpm 12 V direct current standard dynamo from the market, which will produce 10 watts power athis full speed.

For applied torque we first design diameter of pinion shaft

Material C45 – 0.45 % carbon $\sigma_{ut}$ = 320 N/mm$^2$

Take FOS = 4

Now, $\sigma_t = \sigma_b = \sigma_{ultimate}$ / FOS = 320/2 = 160 N/mm$^2$.$\sigma_s = \sigma_t$ / 2 = 160/2 = 80 N/mm$^2$.

The pinion shaft is subjected to pure twisting momentWe know,

$T = \pi / 16 \times \sigma_{shear} \times d^3$ 1000 =

3.14 / 16 x 80 x $d^3$

d = 3.97 mm

But we are using 10mm screw so our design is safe

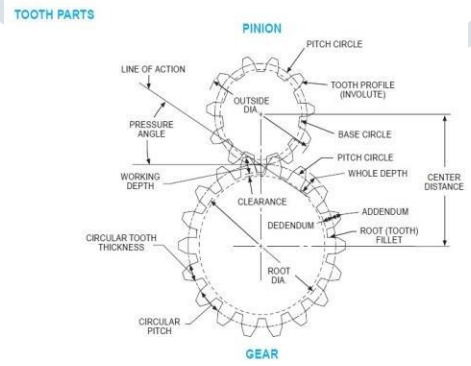


Fig.1.Pinion and Gear.

WT = σ w.b.pc.y

The permissible working stress (σw) in Lewis equation depend upon the material & may be obtained byboth formulae σw = σo x Cv

σo = allowable static stress at elastic limit of the material from design data book alloy steel, heat treated ,

σo = 142 mpa/N/mm²

& Cv = 4.5÷4.5+v = 4.5÷4.5+v

V =πDN÷60 = Πx0.018x360 ÷ 60 = 0.339 m/sCv =

4.5÷4.5+1 = 4.5÷5.5 = 0.818

Y is known as Lewis form factor or tooth from factor

Y = 0.154 – 0.912÷T for 20full depth involutes systemY =

0.154-(0.912÷8) = 0.154-0.0114
Y = 0.1426

Put the values in Lewis equationWT=
σo x Cv x b x pc xY
= 455000000 x 0.818 x 0.015 x (πx0.25÷100) x 0.1426
= 3040.49N
= 310 KG

Now torque will remain same throughout gear but force will change according to diameterT = f

x R
= 43.871 = f x 0.125F =
351N = 35 kg
.'. max load on gear teeth will be 35 kg.
310 > 35
.'. our design is safe.

## VI. CONCLUSION

The vibration energy of vehicle suspension system is wasted in the form of heat energy. By using regenerative suspension system the wasted energy is converted into the useful energy like electrical energy and some amount fuelconsumption is reduced. From the appearance of full performance including oscillation guide capacity, regenerative efficiency and application reliability. By using advanced technology regenerative system can became important in vehicle manufacturing industry. By using regenerative system electrical energy is produced.

## VII. REFERENCE

[1] Akhilesh Kumar Gupta , Sadik Javed Mujawar , Faisal Javed Mirza , Umair Noor Mohd Meer , Sanif Rafique Peje. "*Regenerative Suspension System*" IJCRT- Volume 6, Issue 2 April 2018.

[2] Dr. Seema Tiwari, Manish Kumar Singh, Amit Kumar. "*Regenerative Shock Absorber: Research Review*" International Journal of Engineering Research & Technology (IJERT) - Vol. 9 Issue 05, May-2020.

[3] Prof. Smitha B.S., Hibel Hussain, Johnjo Josmon, Muhammed Nihal, Rohit. "*Design and Simulation of Regenerative Suspension System*" International Research Journal of Engineering and Technology (IRJET)- Volume: 08 Issue: 07 -July2021

[4] Mohd Azman Abdullah, Jazli Firdaus Jamil,Razlan Razali."*DESIGN OF ENERGY REGENERATIVE SUSPENSIONTEST RIG*" ARPN Journal of Engineering and Applied Sciences. VOL. 11, NO. 22, NOVEMBER 2016.

[5] Abhijit Lendhe, Nikhil Mangvade, Prasad Naik, Pratik Jadhav. "*Regenerative Suspension System* " International Journal of Recent Research in Interdisciplinary Sciences-(IJRRIS),Vol.2,Issue.2,June2015.

[6] Ran Zhang, Xu Wang, Sabu John. "*A Comprehensive Review of the Techniques on Regenerative Shock Absorber Systems* " Published: 7 May 2018 .