Regenerative Shock Absorber

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***Abstract*-**With the increasing quantity of the possessed automobile, it has received a great deal of attention from automobile manufactures .To protect 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.

Keywords:-*Regenerative Shock Absorber, Energy Regeneration, Rack and pinion mechanism.*

I. INTRODUCTION

Energy recovery and energy harvesting has been more popular subject with increasing environmental pollution. The automobile manufacturing countries have intensified their researches on the energy efficient vehicles.To protect the environment and reduce vehicle emission and fuel consumption of vehicles.it is necessary to recover energy wasted by the cars, trucks such as the braking energy, engine emissions energy, vibration energy etc. It is seen that only 16% of energy actually use for driving. If only 16% of energy is actually used to drive, where does rest amount of energy go? How can the wasted energy be converted efficiently to electricity? It is well known that automobiles are insufficient, wasting overs 74% of energy stored in fuel as a heat, Major energy losses are engine losses (62.5%), ideal and standby (17.2%), braking losses (5.8%), drive line losses (5.2%). accessory usage (2.55), regenerative braking system developed and successfully implemented in electrical vehicles.one important energy loss in automobile is the dissipation of vibration energy in vehicle suspension system. When a vehicle travels in a rough road, the vibration is produced. These vibrations are not yet considered for energy recovery and are wasted through conversion into thermal energy. If the vibration energy is recovered, it is possible to use the regenerative shock absorber to charge the battery of vehicle, instead of alternator, thus alternator load on vehicle engine can be recovered completely. Electromagnetic regenerative shock absorbers convert kinetic energy of vibrations into useful electricity depending on their structural configuration.

A. Problem Statement

Based on research gap identified in literature review, objective and scope of the proposed work is that energy loss from shock absorber is maximum. Main purpose of this research is to develop electromagnetic shock absorber which will be most effective, light in weight along with energy harvesting with smooth ride and comfort. The work is deal with modeling and analysis of proposed electromagnetic shock absorber. The main purpose of this project is to harvest the energy.

B. Objectives

1.To study of various types of shock absorber.
2.To perform theoretical analysis of regenerative of shock absorber.
3.To develop CAD model in using CATIA V5R15 software.
4.To build a prototype of regenerative suspension system and also compare with FEA analysis.

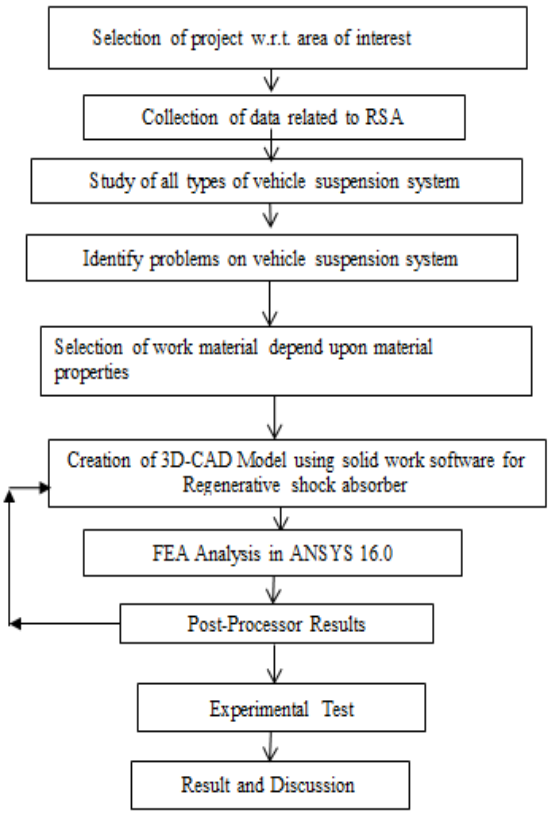
II. LITERATURE REVIEW

The purpose of the literature review is to go through design, analysis and experimental testing of regenerative shock absorber. Energy recyclable power is more sensitive to excitation frequency than to damping ratio and the requirements of ride comfort and safety can be meet by changing the damping ratio properly without reducing energy recyclable power. Primary purpose of vehicle shock absorber is better vehicle comfort and handling rather than energy harvesting. There is conflict between suspension performance and energy harvested. Some advanced optimization strategies should be investigated to deal with the trade-off between power regeneration and ride comfort/ road handling of the suspension system.

A. Scope

1.As discussed in literature review the feasibility and potential of rack & pinion, ball screw, and linear harvesters are studied andanalyzed theoretically and experimentally. Electromagnetic shock absorber has not been studied.
2.Hence the proposed work is to deals with conversion of kinetic energy into electrical energy.
3.This converted electrical energy can be used to chargethe electric vehicle.

III. METHODOLOGY



IV. DESIGN CALCULATION

A. *Force Calculation*

P=12watt
X=0.15m=150mm N=100 rpm
Torque required to drive the alternator shaft
P $=\frac{2\pi NT}{60}$ 12 = $\frac{2\pi\times100\times T}{60}$ T=1.15N-M
Torque required to drive pinion shaft
T=F×r where f= force transmitted through
r=radius of pinion k=stiffness of spring
X=deflection of pinion Xst=static deflection
X=$\frac{FO}{K}$ 3=$\frac{c}{Cc}$ =$\frac{C}{2\sqrt{mk}}$
..C=viscous damping coefficient
..m=mass of vehicle
X=$\frac{Xst}{\sqrt{(2\varepsilon r^2)+(1-r^2)}}$
ω=frequency of shock absorber
ωn = Natural frequency of shock absorber
r =$\frac{\omega}{\omega n}$

Assumption

1. Diameter of tyre(D)=22inch
Kf=28000 N/M …. For buses
Cf=2500 N/sec.m
M=7000kg
ω= (frequency of shock absorber)
V=R× ω
R=Radius of wheel
V=60 KN/Hr V=velocity of vehicle
=16.62m/sec
R=11inch = 0.2794 m
V=Rω16.62=0.2794× ω
ω=$\frac{16.67}{0.2794}$
= 54.66≈ 60

$$\omega = \sqrt{\frac{k}{m}} = \sqrt{\frac{28000}{7000}}$$
$$= 2$$
$$r = \frac{60}{2}$$
$$= 30$$
$$\varepsilon = \frac{C}{Cc} = \frac{2500}{2\sqrt{7000\times28000}} = 0.089$$
$$\varepsilon = 0.089$$
$$X == \frac{0.15}{\sqrt{(2\times0.089\times30)^2+(1-30^2)^2}}$$
$$X = 2.714\times10^{-3}$$
$$F = 28000\times2.714\times10^{-3}$$
$$F = 75.99N \approx 80N$$

For maximum load F= 100N

i. Design Of Pinion

Assumed m=1.5, 2, 2.5
Material = Gray CI FG200
Syt=200 Mpa BHN=179 min
Z=20 teeth For 20° full depth
$m = \frac{D}{Z}$ $m = 1.5mm$ $1.5 = \frac{D}{20}$
D=30mm
Clearance=0.2m $= 0.2\times1.5=0.3$ mm
Working depth (h_E) =1.6 m=1.6×1.5 =2.4mm
Whole depth (h) =1.8× 1.5=2.2mm
Tooth Thickness=1.5708× m =2.3562 mm
Circular pitch=$\frac{\pi D}{n}$ =$\frac{\pi\times30}{20}$ =4.71mm
Diametric pitch=$\frac{1}{m}$ =$\frac{1}{1.5}$ =0.6667mm
Width b=9m to 13 m ≈ 11m 16.5≈ 17mm

Checking for bearing strength
Sb= mbσbY m=1.5 b=17 Y= 0.320
Sb=1.5× 17 × 66.62 × 0.320
Sb=544.02 N
$\sigma b = \frac{1}{3}\times Sut = \frac{1}{3}\times200$ = 66.62 N/mm^2
F= 100 N …S allowable> F required
S allowable=544.02 N
SO Design is safe
F.O.S= $\frac{544.02}{100}$ =5.44
Here pinion is safe against the bending load.

ii.. Design Of Rack

Assumption
m=1.5 mm L=180 mm L=π m z

180=π × 1.5 × z
Z=38.19≈ 40 teeth

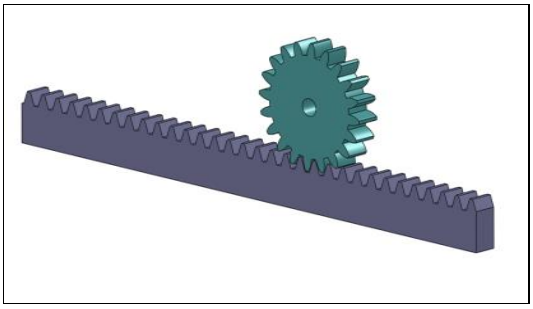


Fig.1 3D CAD MODEL of Rack& Pinion

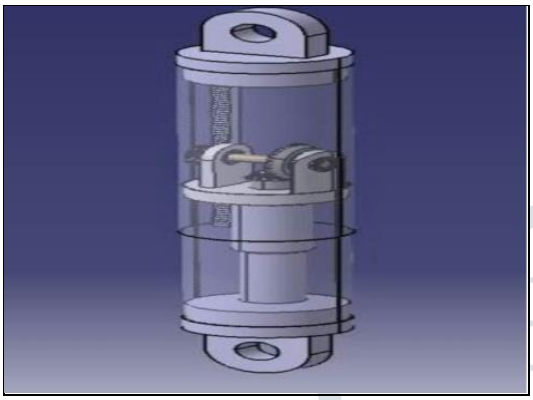


Fig.2 3D CAD Model of Shock Absorber in CATIA V5R15

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