Regenerative suspension system

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Abstract—The given paper concentrate on regenerative suspension system which has the following aims: is to convert mechanical vibration energy (or kinetic energy achieved from the jerks or bump from road surface) with help of rack and pinion arrangement into electrical energy. It can also be used as a controllable damper that can improve the vehicle's ride and handling performance. The modelling makes it possible to evaluate the power which the vehicle suspension system is capable to recuperate while running on roads of different surfaces and under various speeds. In past year, the vehicle suspensions are designed to control the vehicle vibration by dissipating the vibration energy into heat, mostly by hydraulic dampers. If such dissipated energy can be recuperated, the estimated power gain would be an average of 100–400 watts for a mid-size passenger car on an average road at 60 mph. Taking into account the engine and alternator efficiency (about 30% and 55%), this can lead to 2–9% fuel efficiency increase for conventional vehicles In conclusion, only combining vibration reducing performance and energy harvesting efficiency can the regenerative suspensions have a promising prospect

Keyword: vehicle suspension, energy regeneration, mechanical vibration energy, shock absorber.

Introduction

The function of vehicle suspension system is to support the weight of vehicle body, to isolate the vehicle chassis from road disturbances, and to enable the wheels to hold the road surface. Chief elements in suspension are damper. In this system, a source of mechanical energy is harvest by the vibration excited by road unevenness. It is converted into electrical energy to compensate for the energy consumption by the active suspension which is call as "Regenerative Suspension System" (RSS). Shocks absorbers are used to reduce oscillation by absorbing the energy contained in the springs or torsion bars when the wheels of an automobile move up and down. Most of this suspension is design for car, truck but we as a group have built a prototype for bike using mono shock absorber by transfer of motion (energy) to motor with help of rack and pinion arrangement and also using additional devices using bearing (p204), nut and bolt etc. the to and fro of shock absorber is transferred to rack and converted into rotary motion which is connected to sprocket now this motion is transferred to driven sprocket (free wheel). This free wheel is connected (coupled) to a shaft which also is couple too another gear at known distance this gear is meshed with motor which in turn electric energy with every jerks given by uneven road to bike. Hence theoretical give us conceptual model or a system to save the energy which is wasted and increase the performance. Theoretical results show a maximum of 10 % approx. fuel efficiency can be recovered from vehicle suspension system by implementing regenerative shock absorbers.

AIM AND OBJECTIVE OF PROJECT

In the advancing world of 21st century there need to be controlling devices in almost all the places viz. home [controlling of various appliances], office [electronic authentication for access to a specific cabin, restricted area etc.], factory [control and instrumentation], public places [traffic signal control automatic railway crossing signal control etc.] etc.

There are too many new invasion in automobile industry. New car model and in future advance technology will using in automobile. So we decide to do power generation by using shock absorber.

For our project we have decided to use electricity for starter and head light and battery charging since we are basically devising a system that will be user friendly, would be used to power generation.

PROBLEM STATEMENT

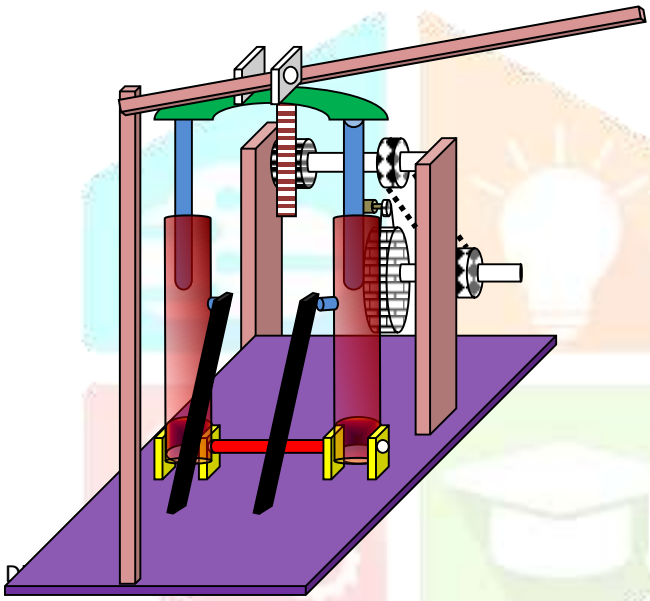
i. The internal combustion engine used in current automobiles has efficiency of around 30% to 40%. From this small efficiency, apart from generating tractive effort for vehicle movement the engine has to run various systems such as lighting system, air conditioning system, ECU of vehicle, etc.
ii. The alternator used to charge battery is directly coupled to engine shaft. As a result of it, the alternators directly or indirectly consume brake power obtained at engine shaft with very low efficiency.
iii. The amount of energy consumed by the alternator is approximately 4% of total energy generated. So this creates a situation for us where need to replace the alternator to some system which will not add up to the engine load and also recover the waste energy which is dissipated to the surrounding.
iv. As per research, we could find two such systems which have high energy potential and is not being utilized i.e. brake power and suspension power.
v. Suspension system seem to be more promising so we decided to develop a system which regenerates the

energy obtained from the continuous displacement of suspension system.

vi. If we couple this system to all four wheels of vehicle, it can fulfil the demand of charging battery. This electricity can later be supplied to other systems.

vii. Currently there is suspension energy regenerating system which works on principles such as hydraulic system, electromagnetic system, pneumatic system, piezoelectric system, etc.

CALCULATION AND PROPOSED SYSTEM



Periphery = π × dia. Of sprocket

36 × 6.25 = π × D

$$D = \frac{36 * 6.25}{\pi}$$

D = 72 mm

Torque transmitted,

T = Force × radius

20.280 x 10^3 = F × 36

F = 563.33N

$$F = \frac{563.33}{9.81}$$

F = 58 Kg

Torque transmitted by shaft,

$T = \pi/16 \times \tau \times d^3$

Select permissible shear stress (τ) from design data book.

τ = 70 N/mm^2

Therefore, 20.28 x 10^3 = π /16 x d^3 x 70

D= 12 mm.

Taking factor of safety = 1.6

D = 1.6 x 12 =19.2 = 20 mm

We select dia. Of shaft = 20mm.

Design of bolt:-

tension

Bolt is to be fastened tightly also it will take load due to rotation. Stress for C-25 steel FT=420 kg/cm. Std- -nominal diameter of bolt is 10mm. From table in design data book, diameter corresponding to M12 bolt is 8.160mm

Let us check the strength:-

Also initial tension in the bolt when belt is fully tightened.

P =30 kg, P = 300 N is the value of force applied by hand

Also, P = Π /4 dc^2x Ft

$$FT = \frac{300*4}{3.14(12*0.81)(12*0.84)}$$

FT = 3.76 N / mm^2

RESULT

Hence we have concluded that by using this regenerative suspension system we can save up to around 0.2-2 ampere of current which can be stored in battery for auxiliary used

Conclusion

In this paper, we proposed a "motion rectifier" based design of electro-magnetic motor enhanced efficiency and reliability for potential application of vibration energy harvesting from vehicle suspensions. "motion rectifier" can transfer the oscillatory motion of vehicle suspension into unidirectional motion of the electrical generator, thus enabling the generator operating in a relatively steady speed with higher efficiency. In such a design, the motion inertia will act as a filtering

capacitor to temporarily storage the energy and smooth the rotation, which can decrease the influences of backlash impact and static friction. An innovative implementation of the motion rectifier is introduced with high compactness and improved efficiency.

When used in an electric vehicle or hybrid electric vehicle the electricity generated by the shock absorber can be diverted to its power train to increase battery life. In non-electric vehicles the electricity can be used to power accessories such as air conditioning. Several different systems have been developed recently, though they are still in stages of development and not installed on production vehicles.

This could be used on electric or hybrid vehicles (or normal vehicles) to capture energy which would otherwise be absorbed and wasted, and then convert it into electricity. The regenerative shock absorbers can harvest the power in a continuous way. On the smooth highway road, the regenerative shock absorbers can improve the fuel efficiency by 2%, and on bumpy roads up to 10% increase can be expected

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