Power Generation from Suspension due to Piezo Electric Transducer

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ABSTRACT

Energy is utilized by each and every organism in the universe for its survival. As in this fast moving world, the population is increasing day by day and the conventional energy sources are lessening. The extensive usage of energy has resulted in an energy crisis over the few years. Therefore to overcome this problem we need to implement the techniques of optimal utilization of conventional sources for conservation of energy. In this paper it is mainly considered on generating the electricity in the suspension system of the automobile and store the energy in the battery or alternator as conventional method by simply driving the vehicle. Current sports bikes are normally without kickers and this power generation method can be used to charge the battery within short span of time. In this paper few of the power generation methods in the vehicle suspension system is discussed.These vibrations are generated when vehicle passes over a road bump. The kinetic energy generated from the suspension system is converted into electrical power by using various mechanisms. This paper is mainly concentrate on few power generated mechanism in vehicle suspension system. The followings are the topics considered to be reviewed in power generation methods.

Keywords: *Suspension System, Piezo Electric, etc.*

1. INTRODUCTION

The concept of increasing the fuel efficiency of a petrol engine in this project, is to pre-heat the intake air which is flowing through the carburetor. The humidity in the atmospheric air affects the petrol vaporization in the carburetor. Therefore, by pre-heating the inlet air to the carburetor for a considerable amount, the vaporization can be ease and in turn complete combustion is achieved. Moreover by reducing the water vapour to the engine, the steam formation in the engine can be reduced pitting of the engine cylinder, piston and exhaust pipe.

The pre-heating of inlet air to the engine can be achieved by fixing a heat exchanger inside the exhaust pipe. The atmospheric air is sucked through the heat exchanger to the carburetor. The air which is flowing though the heat exchanger gets heated by the engine exhaust gas. This reduces the water vapour in the inlet air and the temperature of the air is raised. The temperature raise causes complete combustion in the engine and it is also more suitable for warming up the engine in cold conditions. The output of the engine exhaust gas is given to the input of the ignition system, so that the proper ignition is occurred. In this case, the efficiency of the engine is also increased.

The exhaust gas is given to the heating chamber as shown in figure. The exhaust hot air is used to pre-heat the input air into the ignition system. So far this type of system has not been introduced in two wheelers. So this may be very useful to two wheelers without any complication and maintenance. But the air pre-heater design depends on the exhaust pipe fitted to the particular two wheeler engine.

The design is simple, cheap and does not give any trouble to the engine. The output of the engine exhaust gas is given to the input of the ignition system, so that the proper ignition is occurred. In this case, the efficiency of the engine is also increased. This system can be used in all type of petrol engine two wheelers and also can be used in small petrol engines used in various industries.

3. SCOPE:

In our country due to increased paying capacity, advanced lifestyle and rapidly growing industrialization, the need & demand of transportation is increasing day- by- day. The number of vehicles rolling on the road is increasing daily. Hence chances of accidents are increasing while crossing the road especially by the children and old persons. So it became necessary to install the speed breakers (in true sense speed reducers) at the school building or Hospital building- side road or highway. If these speed breakers Yes! In true sense it is speed and ultimately breaker the opposing impact energy supplied by the hard speed breaker will apply massive thrust impact on the suspension system of the vehicle. This impact force can be used for power generation using regenerative method and use to charge battery and release load of alternator or dynamo from engine.

Here on working this group task we over-come our following needs: - We became able to have market survey Doped capability of designing a system by collecting necessary data. Learnt actual practical fabrication processes of the sub-components of the system. Planning the cost estimation and budget. Duties of a technician or an Engineer.

4. CONSTRUCTION:

We are going to develop a power from Suspension systems. In this, the coil spring type suspension is used. When vehicle is going by bumpy road, the suspension system comes into act.

The vibration energy from suspension system is carry forward to Piezo electric transducer. The basic diagram of setup is as follow:

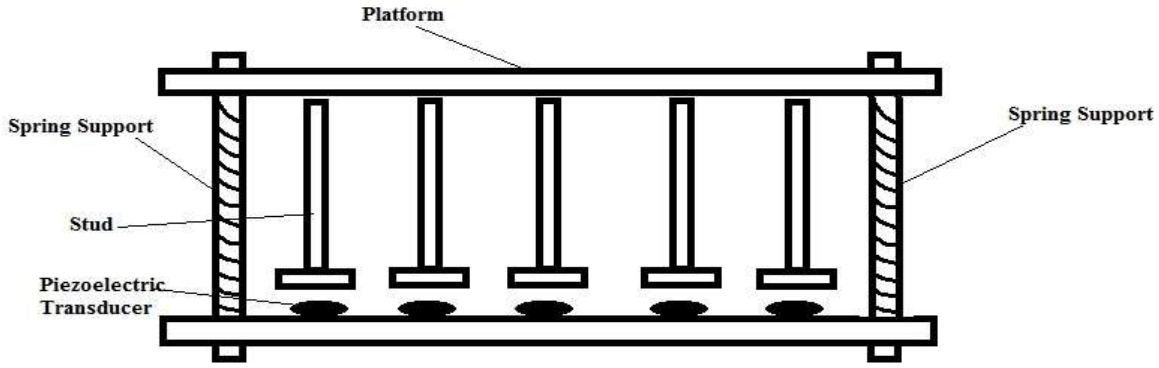

Fig4.1 CAD Model

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4.1 Working:

Regenerative suspension basically new concept of non-conventional energy generation. It is electro-mechanical energy generating machine. This machine converts reciprocating motion in to electric energy with help piezo-electric transducer. Here first important point is how we get reciprocating motion, which is prime input in the system. For that we use weight of moving vehicles that run on roads. We put our mechanism on bike suspension, the head of piezo. When vehicles move on speed breaker spring will be reciprocate. The studs in contact with piezoelectric transducer arrangement convert reciprocating motion in to electrical energy.

5. COMPONENTS OF SYSTEM:

5.1 Spring:

Spring is elastic object used to store mechanical energy. Springs are usually made out of spring steel. There are large number of spring designs; in everyday usage the term obtain refers to coil springs. Small spring can be wound from prehardened stock, will larger ones are made from annealed steel and hardened after fabrication. When coil spring is compressed or stretched slightly from rest, from the force it exert is approximately proportional to its change in length. Depending on the design and required operating environment, any material can be used to construct a spring, so long as material has the required combination of rigidity and elasticity.

Fig.5.1.1 Coil spring

In our project coil spring is used. The coil spring made by winding a wire around a cylinder and conical spring. A coil spring, also known as helical spring, in mechanical device, which is typically used to store energy due to resilience and subsequently release it. They are made of an elastic material formed into the shape of helix which returns to its natural length when unloaded the quality of is judged from the energy it can absorb. The spring which is capable of absorbing the greatest amount of energy for the given stress is best one.

5.2 Piezo electric transducer:

A transducer can be anything which converts one form of energy to another. Piezoelectric material is one kind of transducers. We squeeze this material or we apply force or pressure on this material it converts it into electric voltage and this voltage is function of the force or pressure applied to it. The material which behaves in such a way is also known as piezoelectric sensor. The electric voltage produced by piezoelectric transducer can be easily measured by voltage measuring instruments, which can be used to measure stresses or forces. The physical quantity like mechanical stress or force cannot be measured directly. Therefore, piezoelectric transducer can be used.

Piezoelectric transducer consists of quartz crystal which is made from silicon and oxygen arranged in crystalline structure (SiO2). Generally, unit cell (basic repeating unit) of all crystal is symmetrical but in piezoelectric quartz crystal it is not. Piezoelectric crystals are electrically neutral. The atoms inside them may not be symmetrically arranged but their electrical charges are balanced means positive charges cancel out negative charge. The quartz crystal has unique property of generating electrical polarity when mechanical stress applied on it along certain plane. Basically, there are two types of stress. One is compressive stress and other is tensile stress.

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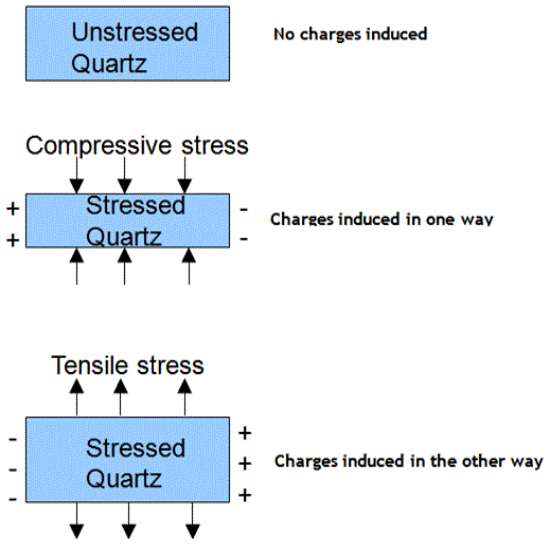

Fig.5.2.2 Stresses in Piezo electric

When there is unstressed quartz no charges induce on it. In case of compressive stress, positive charges are induced in one side and negative charges are induced in opposite side. The crystal size gets thinner and longer due to compressive stress. In case of tensile stress, charges are induced in reverse as compare to compressive stress and quartz crystal gets shorter and fatter.

Piezoelectric transducer is based on principle of piezoelectric effect. The word piezoelectric is derived from Greek word piezo, which means to squeeze or press. Piezoelectric effect states that when mechanical stress or forces are applied on quartz crystal, produce electrical charges on quartz crystal surface. The piezoelectric effect is discovered by Pierre and Jacques curie. The rate of charge produced will be proportional to rate of change of mechanical stress applied on it. Higher will be stress higher will be voltage. One of the unique characteristics of piezoelectric effect is that it is reversible means when voltage is applied to them ,they tends to change dimension along certain plane i.e. quartz crystal structure is placed into electric field, it will deform quartz crystal by amount proportional to strength of electric field. If same structure is placed into an electric field with direction of field reversed, the deformation will be opposite.

6.SPECIFICATION OF COMPONENTS:

Spring:

G=85*10^3N/mm^2

τ =1300N/mm^2

c=6

Length =202 mm

7. CALCULATION

7.1 Springs

Maximum Deflection = δ_{max}= 125 mm

Maximum Mass of vehicle = m = 980 kg

Maximum Force = F = mg

= 980* 9.81

= 9613.8 N

Spring Index = C = 6

Modulus of Rigidity = G = 85 * 10^3 N/mm^2

Maximum Shear Stress = τ = 1300 N/mm^2

7.2 Wire Diameter

Wahl Factor shear stress factor = $K_w = \frac{4C-1}{4C-4} + \frac{0.615}{C}$

$= \frac{4*6-1}{4*6-4} + \frac{0.615}{6}$

= 1.2525

$\tau = \frac{Kw*8*C*F}{\pi d^2}$

$1300 = \frac{1.2525 * 8 * 6 * 9613.8}{\pi d^2}$

Wire Diameter = d = 11.89 = 12 mm

7.3 Mean Coil diameter

Mean Coil diameter =D = C * d

= 6* 12

= 72 mm

7.4 Number of Coils

Spring Stiffness = K = $\frac{Fmax}{\delta max}$

$= \frac{9613.8}{125}$

= 76.91N/mm

Now

$K = \frac{Gd}{8C*c^3*n}$

$76.91 = \frac{85*10^3*12}{8*6^3*n}$

n= 7.67 = 7

Assume Plain End condition, so

Total number of coils = n'= n

= 7

7.5 Solid length

Ls = (n+1)*d

= (7+1)*12
= 96 mm

7.6 Free length

Lf = Solid Length + Maximum Deflection + Total Clearance
= Ls + δ_{max}+ 15 % of δ_{max}
= 96 + 125 + 0.15* 125
= 239.75 mm

7.7Pitch of coil

Free length = Lf = p*n + d
239.75 = p* 8 + 12
p = 28.46 mm

8. Conclusion:

This method being economical and user-friendly with robust linkages, promises dependable output for usage. This even adds to the economy of the country by utilizing the growing traffic. This helps reaching our aim to be a power sufficient country.

9. References:

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