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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 ,PiezoElectric ,etc.*

[1] .INTRODUCTION

The main principle of a piezoelectric transducer is that a force, when applied on the quartz crystal, produces electric charges on the crystal surface. ... As the charge produced is very small, a charge amplifier is needed so as to produce an output voltage big enough to be measured . A quartz crystal is a piezoelectric material that can generate a voltage

proportional to the stress applied upon it. For the application, a natural quartz crystal has to be cut in the shape of a thin plate of rectangular or oval shape of uniform thickness.

2.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 thisgrouptaskweover-comeourfollowingneeds:-WebecameabletohavemarketsurveyDoped 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.

3.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.
Thevibrationenergyfromsuspensionsystemiscarryforwardto Piezoelectrictransducer.Thebasicdiagramofsetup is as follow:

3.1 Working:

Regenerativesuspensionbasicallynewconceptofnon-conventionalenergygeneration.Itiselectromechanical energy generating machine. This machine converts reciprocating motion in to electric energy with help of 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 piezo electric transducer arrangement convert reciprocating motion into electrical energy.

4.COMPONENTS OF SYSTEM:

4.1 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 pre hardened 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.4.1Coilspring

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 whichreturnstoitsnaturallengthwhenunloadedthequalityofisjudgedfromtheenergyitcanabsorb.Thespringwhichi scapable of absorbing the greatest amount of energy for the given stress is best one.

4.2 Piezoelectric 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 electricvoltageandthisvoltageisfunctionoftheforceorpressureappliedtoit.Thematerialwhichbehavesinsuchaway 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 (SiO_2). 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.

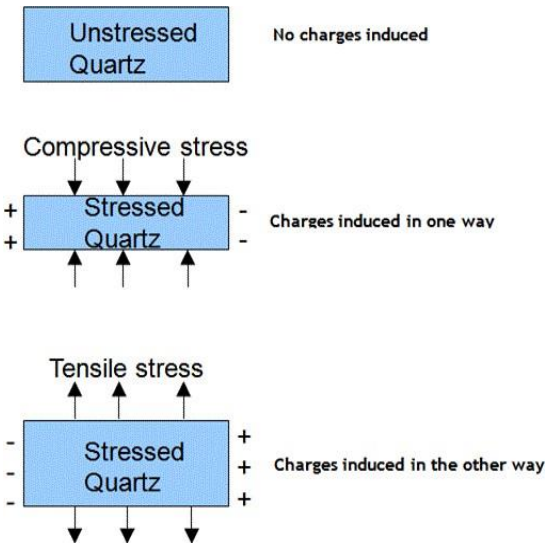

Fig.4.2.StressesinPiezoelectric

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.quartzcrystalstructureisplacedintoelectricfield,itwilldeformquartzcrystalbyamountproportionaltostrengthof electric field. If same structure is placed into an electric field with direction of field reversed, the deformation will be opposite.

4.3 Hydraulic Cylinder :

Cylinders allow hydraulic systems to apply linear motion and force without mechanical gears or levers by transferring the pressure from fluid through a piston to the point of operation.

Hydraulic cylinders are at work in both industrial applications (hydraulic presses, cranes, forges, packing machines), and mobile applications (agricultural machines, construction equipment, marine equipment). And, when compared with pneumatic, mechanical or electric systems, hydraulics can be simpler, more durable, and offer greater power. For example, a hydraulic pump has about ten times the power density of an electric motor of similar size. Hydraulic cylinders are also available in an impressive array of scales to meet a wide range of application needs.

A hydraulic cylinder (also called a linear hydraulic motor) is a mechanical actuator that is used to give a unidirectional force through a unidirectional stroke. It has many applications, notably in construction equipment, manufacturing machinery, and civil engineering.

Hydraulic cylinders get their power from pressurized hydraulic fluid, which is typically oil. The hydraulic cylinder consists of a cylinder barrel, in which a piston connected to a piston rod moves back and forth. The barrel is closed on one end by the cylinder bottom (also called the cap) and the other end by the cylinder head (also called the gland) where the piston rod comes out of the cylinder.

Parts

Cylinder barrel

Cylinder base or cap

Cylinder head

Piston

Piston rod

Seal gland

5.SPECIFICATION OF COMPONENTS:

Spring:G=85

*10^3N/mm^

2τ=1300N/m m^2c=6

Length=202mm

6.CALCULATION

6.1 Springs

Maximum Deflection=δ_{max}=125mm

Maximum Mass of

vehicle=m=980kgMaximumForc e =F=mg

= 980*9.81

=9613.8 N

Spring Index=C=6

Modulus of

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

ShearStress=τ=1300N/mm^2

6.2 Wire Diameter

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

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

$$= 1.2525$$

$$\tau = \frac{Kw*8*C*F}{\pi d2}$$

$$1300 = \frac{1 * 2525 * 8 * 6 * 9613.8}{\pi d2}$$

Wire Diameter = d = 11.89 = 12 mm

6.3 Mean Coil diameter

Mean Coil diameter = D = C * d

= 6* 12

= 72 mm

6.4 Number of Coils

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

$$= \frac{9613.8}{125}$$

= 76.91N/mm

Now

$$K = \frac{Gd3}{8C*c*n}$$

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

n= 7.67 = 7

Assume Plain End condition, so

Total number of coils = n'=n

= 7

6.5 Solid length

Ls = (n+1)*d

= (7+1)*12

= 96 mm

6.6 Free length

L f = Solid Length + Maximum Deflection + Total Clearance

= Ls + δ_{max} + 15 % of δ_{max}

= 96 + 125 + 0.15* 125

= 239.75 mm

6.7 Pitch of coil

Free length=L f=p*n +d

239.75=p*8 +12p

=28.46 mm

7.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.

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