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Power Generation from Railway Track using Piezoelectric Crystal

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Abstract: In this era of expanding energy costs and decreasing supplies of non-renewable energy sources, it has become necessary to set up renewable energy based local power sources. This paper describes the use of piezoelectric materials in order to harvest energy from vibrations of railway track for generating and accumulating the energy. Railway locomotive and coaches produce high vibration due to heavy load during running time. The vibration is captured by using piezoelectric crystals. This idea is also applicable to some large vibration sources which can find from nature. The energy so produced is stored in a battery which is further used for other applications.

Keywords: Harvest Energy, Non-renewable, Piezoelectric Crystal, Railway Tracks, Crystalline Material.

I. INTRODUCTION

Now a day's electrical energy is one of the most important issues around the world. Especially in countries like India, Bangladesh, Pakistan, Bhutan, etc. energy crisis is a big problem. Renewable energy sources can be a solution to this energy crisis problem. As we know natural resources are exhausting at large amount. That's why researchers are trying to seek alternative energy sources from nature. That must be green and Eco-friendly. Human beings have already started to use energy harvesting technology in the form of solar, windmill, geothermal and solar energy. The energy came from natural sources are called as renewable energy. Usage of Piezoelectricity, a sustainable power source reaping technique, will lead the following force era into a possible and more efficient of energy. Piezoelectric materials can be utilized for changing encompassing vibrations into electrical vitality that would then be able to be put away also, used to various purposes.

This paper introduces a proposal to provide electricity, an important demand for all railway stations, by utilizing Piezoelectric technique. Huge wastage of power takes place at railway stations due to continuous and sometimes unnecessary usage of electrical appliances. The power thus generated can be used at nearby railway stations thereby saving large amount of energy, eliminating transmission losses and saving money as the power is now generated at a cheaper rate. It discusses how to harvest electricity from different places related to a railway station. Train is the fourth largest transportation platform in India. Further, many cars and buses pass the nearby roads and highway engaged in transporting rail passengers to or from the train stations. There is an opportunity to take advantage of these large amount of moving people and vehicles. Nearby Roads, footpaths, terminal floor will be covered by piezoelectric materials to harvest electricity. Such materials can also be employed in rail tracks near the stations.

A. What is Piezoelectric Crystal?



Fig. 1 Piezoelectric crystal

One of the small scale energy resources piezoelectric crystal. When these crystals are automatically deformed then they produce a tiny voltage which is known as piezoelectricity. This kind of renewable energy cannot be suitable for industrial situations. The main concept of these crystals is to provide Piezoelectricity in response to applied automatic stress which can be reversible within the crystals. This twist can be done through only nanometres and it has helpful applications like the fabrication as well as sound detection.

B. Working of Piezoelectric Crystal

Piezoelectric crystal is a hexagonal in shape, and it consists three axes namely optical, electrical, & mechanical. It is named a piezoelectric effect. The working of this crystal is whenever a pressure is applied to the crystal then it generates the electricity. When an electromagnetic force is applied on crystals, afterward the crystals begin vibrating otherwise demonstrate a mechanical growth and reduction. It is known an inverse piezoelectric effect.

II. PIEZOELECTRICITY

When force is applied to the crystalline material small amount of electricity will produce that changes their shape in some way or when small amounts of pressure are applied to a quartz crystal, a small voltage is produced due to the movement of electrons.

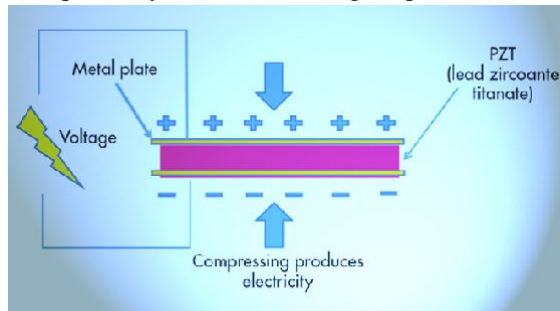
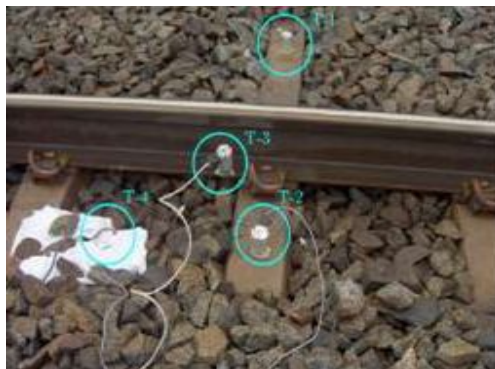
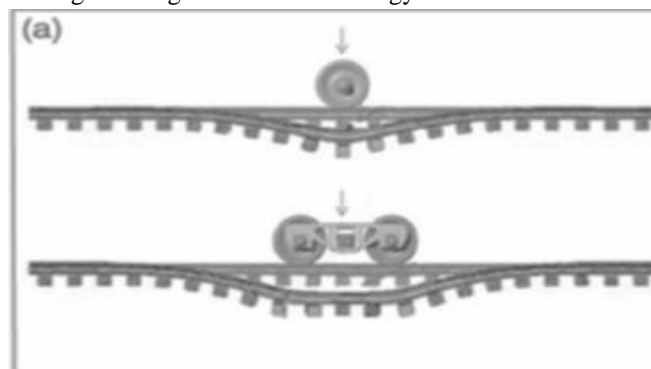


Fig. 2 Principle of piezoelectricity

A. Vibration Analysis

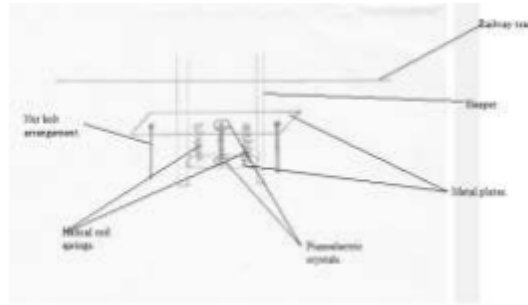


This paper analyses point T1, T2, T3 and T4 where the frequency at point T3 is constant. But now for this concept only vibration analysis of point T1, T2, T4 and T3 is directly in contact with the tracks where the vibration is very high and where it is not possible to convert this high vibration energy into equivalent electrical energy by usage of the piezoelectric crystals. After the analysis of vibrations of point T1, T2 and T4 ,it is clear that these vibrations can easily be converted into electrical energy. We are mostly concentrating on point T4 because we don't want to interrupt the sleepers anyhow. We are achieving the vibrations at point T4 by proper arrangements of metal plates as shown in the procedure. We are also implementing the helical coil springs in between two metal plates to increase the vibrations and thus generate good amount of energy.

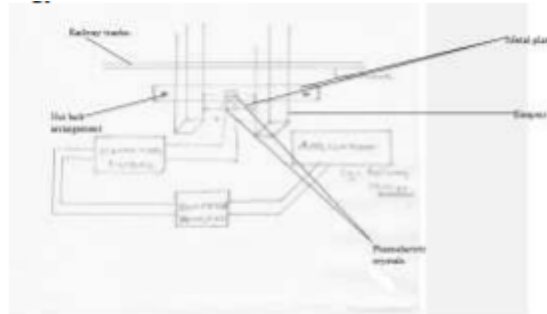


III. PROCEDURE

We are applying these piezoelectric crystals on the metal plates which are attached to the sleepers beneath railway tracks. As shown in figure.



We are applying on the metal plates because we don't want to interrupt the sleepers by any chance. By using the metal plates the complete vibration on the sleepers will be transferred onto the plates, which would be then converted and utilized. Hence we are placing the piezoelectric crystals on these metal plates in such a way that the maximum vibration energy is converted into equivalent electrical energy. This converted energy is put in batteries and thus used for several purposes.



The frequency of railway trains is very high In a city like Mumbai,. It is known there is a running of train in every three minutes. So with the implementation of this concept a lot of energy can be generated because the frequency of train is very good. The energy generated will be used in the nearby railway stations. This energy will be thus useful for the working of all the electrical appliances used in the stations. Thus the concept will be able to supply energy at low cost rate as of now. The energy created can also be used for the nearby farms if it is needed. The best advantage of the usage of the energy nearby is the less transmission loss and less storage problems. The whole generation of energy can be directly used for various purposes without any much loss and the energy produced is pollution free.

IV. CONCLUSIONS

From this paper it can be studied that electrical energy is induced from the vibrations produced due to the running train on the track. The railway stations required plenty amount of energy. the energy produced by this piezoelectric crystal can be used in neighboring railway station for various electrical appliances. The energy produced by this system is pollution free and eco-friendly.it will save the electricity at large amount and thereby non-renewable resources get saved

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