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Piezoelectric Based Energy

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***Abstract*— In the present paper a review on piezoelectric sensing of mechanical deformations and its uses is highlighted.**

I. INTRODUCTION

Recent advances in energy harvesting have been intensified due to urgent need of portable, wireless electronics with extensive life span. The idea of energy harvesting is applicable to sensors that are placed and operated on some entities for a long time, or embedded into structures or human bodies, in which it is troublesome or detrimental to replace the sensor module batteries. Such sensors are commonly called" self-powered sensors".The energy harvester devices are capable of capturing environmental energy and supplanting the battery in a stand-alone module, or working along with the battery to extend substantially its life. Vibration is considered one of the most high power and efficient among other ambient energy sources, such as a solar energy and temperature difference. Piezoelectric and electromagnetic devices are mostly used to convert vibration to ac electric power. For vibratory harvesting, a delicately-designed power conditioning circuit is required to store as much as possible of the device-output power into a battery. The design for this power conditioning needs to be consistent with the Electric characteristics of the device and battery to achieve Maximum power transfer and efficiency. This study offers an overview on various power conditioning electronic Circuits designed for vibratory harvester devices and their Applications to self powered sensors. Comparative Comments are provided in terms of circuit topology Differences, conversion efficiencies and applicability to a Sensor.

II. WORKING PLAN

A. Harvest Energy from Vibration of Railway Tracks Using Peizosensors

Piezoelectricity is an effect that occurs when mechanical stress is applied to certain materials .An electrical polarization is set up in the crystal with the result that the faces become electrically charged. The charge reverses if the compression changes to tension. Because the effect is reversible electric fields applied across the material causes it to contract or expand according to the sign of the field. The piezoelectric stress and an electrical voltage in solids .It is reversible: an applied Effect describes the relation between a mechanical stress will generate a voltage and an applied voltage will change the shape of the solid by a small amount (up to a 4% change in volume).In physics the piezoelectric effect can be described as the link between electrostatics and mechanics. The piezoelectric effect occurs only in non conductive materials .Piezoelectric materials can be divided in 2 main groups: crystal and ceramics.

III. FEASIBILITY

Rail transport is one of the most common modes of carrying cargo and passengers from one place to another. The prevalence of road transportation created the need of train crossings and the danger associated with them. In many developed countries, trains are tracked in real-time using a variety of sensors and communication technologies. The data provided by the sensors allows transport authorities to stop vehicles from crossing the track when a train is near, or direct train traffic on rail turnouts or switches. Even with these high-tech solutions, transport authorities still lose contact with the rail cars due to lack of cellular service. Some trains use a third rail to provide communications, among other uses. These third rails are more reliable than wireless communications, but still have challenges. Organic build up due to foliage and dead leaves can cause the train to lose connection and "disappear" on the rail.

A. Feasible Idea

I make use of piezo-electric devices to generate electricity. The specific application I was going for was in the railroad realm whereby such transducers could be placed in the roadbed under the track structure itself and when deformation in the track occurred as a result of a train rolling on top of it, by virtue of this action, pressure would be placed upon the piezo-electric transducer itself, thereby changing applied pressure into electricity. I figured, based on the number of transducers placed one next to another and so on down a railroad line, for example, with miles and miles of such placed just beneath the track, a considerable amount of electricity could be generated.

IV. TECHNICAL INFORMATION

Much of the abundant mechanical energy around us is irregular and oscillatory and can be somewhat difficult to efficiently tap into. Typical energy harvesting systems tend to be built for low power applications in the mill watts range. A new patent-pending electromagnetic energy

harvester capable of harnessing the vibrations of a locomotive thundering down a stretch of track to power signal lights, structural monitoring systems or even track switches. As a train rolls down the track, the load it exerts on the track causes vertical deflection. This displacement could engage a regenerative device like an electromagnetic harvester and generate enough power to operate local railway applications, which is especially useful in remote areas where electrification is not cost effective. Harvesting such energy is much more efficient with regular, unidirectional motion, but track vibrations caused by a moving train are pulse-like, bidirectional and somewhat erratic. A new harvester is required which capable of converting irregular, oscillatory rail track vibrations into regulated unidirectional rotational motion, similar to the way that an electric voltage rectifier converts AC voltage into DC.

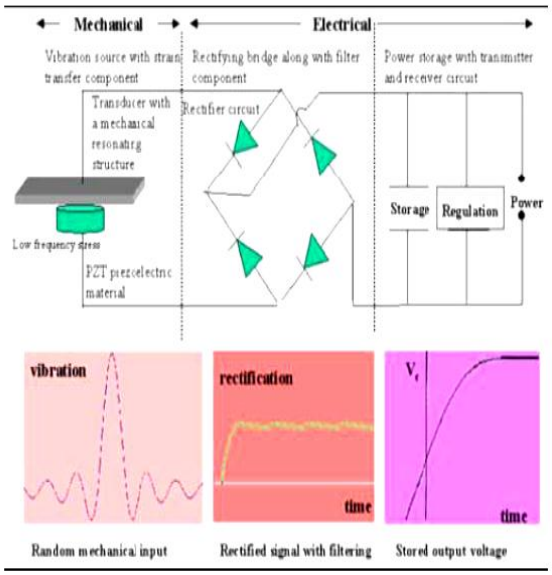

Fig. 1 Data of the experiment performed connecting such transducers in parallel

V. Unique Selling Point

- Low cost
- High sensitivity
- High mechanical stiffness
- Broad frequency range
- Exceptional linearity
- Excellent repeatability
- Unidirectional sensitivity
- Small size

VI. Implementation In Real Life

- Ultrasonic transmitters and receivers.
- Frequency references. (USE AS ENERGY HARVESTOR FROM RAILWAY TRACK)
- Temperature sensors (resonant frequency changes with temperature)
- Accelerometers (used with a seismic mass) (See discussion in section 5-3.3 in
- Cars tens text). See notes on accelerometer calibration in 9.7 and 9.8 DRM
- Microphones and loudspeakers (small loudspeakers with poor audio characteristics =
- Beepers)
- Pressure sensor
- Force sensor

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