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Research Article

Generation of Electrical Power through Foot steps

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Abstract

Even if the planet doubled the amount of solar and wind power available tomorrow, there would still be a shortage of clean electricity. We need to grab energy from wherever we can find it, which is why piezoelectricity the charge that gathers in solid materials like crystal and ceramic in response to strain has recently begun to pique the interest of entrepreneurs and scientists alike. One of the most popular uses for piezoelectricity in the past few years relies on roads and sidewalks. The present project deals with the generation of electricity through traffic pressure by placing piezoelectric generators on the roads the axial load of the traffic pressure deforms the generator and thus produces the electric energy as an output, this output may use for the street lighting, and many more aspects.

Keywords: *Piezoelectricity, Foot steps, Electrical power*

1. Introduction

The one of major source of external energy which can used to separate outer orbit electrons away from their parent atom is pressure. Whenever you speak into a telephone or any similar type of microphone, the pressure waves of the sound energy which your voice generates make a diaphragm move. This diaphragm movement can be used to give rise to an electric charge in the following away. There exit in nature certain materials whose crystals develop an electric charge when pressure (as form a moving diaphragm) is exerted or them. Quartz, tourmaline and Rochelle salts are examples. If a crystal from one of the material is placed between two metal plates and pressure is exerted on the plates, an electric charge will be created between the plates. It size will depend on the amount of pressure exerted.

It is also possible to convert electrical energy back into mechanical energy by placing an electric charge on the plates of such a device. The crystal will then expand or contract by a small amount, depending on the amount and type of the charge applied; and the mechanical energy so created can also be put to use Appearance of an electric field in certain non-conducting crystals as a result of the application of mechanical pressure. Pressure polarizes some crystals, such as quartz, by slightly separating the centers of positive and negative charge. The resultant electric field is detectable as a voltage. The converse effect also occurs: an applied electric field produces mechanical deformation in the crystal. Using this effect, a high-frequency alternating electric current (see alternating current) can be converted to an ultrasonic wave of the same frequency, while a mechanical vibration, such as sound, can be converted into a corresponding electrical signal. Piezoelectricity is utilized in microphones, phonograph pickups, and telephone communications systems. The application of a mechanical stress produces in certain dielectric (electrically non-conducting) crystals an electric polarization (electric dipole moment per cubic meter) which is proportional to this stress. If the crystal is isolated, this polarization manifests itself as a voltage across the crystal, and if the crystal is short-circuited, a flow of charge can be observed during loading.

Conversely, application of a voltage between certain faces of the crystal produces a mechanical distortion of the material. This reciprocal relationship is referred to as the piezoelectric effect. The phenomenon of generation of a voltage under mechanical stress is referred to as the direct piezoelectric effect, and the mechanical strain produced in the crystal under electric stress is called the converse piezoelectric effect. See also Polarization of dielectrics.

The necessary condition for the piezoelectric effect is the absence of a center of symmetry in the crystal structure. Of the 32 crystal classes, 21 lacks a center of symmetry, and with the exception of one class, all of these are piezoelectric. Hydrostatic pressure produces a piezoelectric polarization in the crystals of those 10 classes that show pyroelectricity in addition to piezoelectricity. See also Crystallography Pyroelectricity. Piezoelectricity is the ability of some materials (notably crystals and certain ceramics, including bone) to generate an electric field or electric potential in response to applied mechanical stress. The effect is closely related to a change of polarization density within the material's volume. If the material is not short-circuited, the applied stress induces a voltage across the material. The word is derived from the Greek Piezo or piezein, which means to squeeze or press.

The piezoelectric effect is reversible in that materials exhibiting the direct piezoelectric effect (the production of an electric potential when stress is applied) also exhibit the reverse piezoelectric effect (the production of stress and/or strain when an electric field is applied). For example, lead zirconate titanate crystals will exhibit a maximum shape change of about 0.1% of the original dimension. The effect finds useful applications such as the production and detection of sound, generation of high voltages, electronic frequency generation, microbalances, and ultra fine focusing of optical assemblies. It is also the basis of a number of scientific instrumental techniques with atomic resolution, the scanning probe microscopes such as STM, AFM, MTA, SNOM, etc., and everyday uses such as acting as the ignition source for cigarette lighters and push-start propane barbecues. The pyroelectric effect, where a material generates an electric potential in response to a temperature change, was studied by Carl Linnaeus and Franz Aepinus in the mid-18th century. Drawing on this knowledge, both René Just Hauy and Antoine César Becquerel posited a relationship between mechanical stress and electric charge; however, experiments by both proved inconclusive.

The first demonstration of the direct piezoelectric effect was in 1880 by the brothers Pierre Curie and Jacques Curie. They combined their knowledge of pyroelectricity with their understanding of the underlying crystal structures that gave rise to pyroelectricity to predict crystal behavior, and demonstrated the effect using crystals of tourmaline, quartz, topaz, cane sugar, and Rochelle salt (sodium potassium tartarate tetrahydrate). Quartz and Rochelle salt exhibited the most piezoelectricity.

2. Global warming

Global warming is the increase in the average measured temperature of the Earth's near-surface air and oceans since the mid-20th century, and its projected continuation. Global surface temperature increased 0.74 ± 0.18 °C (1.33 ± 0.32 °F) during the 100 years ending in 2005. The Intergovernmental Panel on Climate Change (IPCC) concludes that most of the increase since the mid-twentieth century is "very likely" due to the increase in anthropogenic greenhouse gas concentrations. Natural phenomena such as solar variation combined with volcanoes probably had a small warming effect from pre-industrial times to 1950 and a small cooling effect from 1950 onward.

Climate model projections summarized by the IPCC indicate that average global surface temperature will likely rise a further 1.1 to 6.4 °C (2.0 to 11.5 °F) during the twenty-first century. This range of values results from the use of differing scenarios of future greenhouse gas emissions as well as models with differing climate sensitivity. Although most studies focus on the period up to 2100, warming and sea level rise are expected to continue for more than a thousand years even if greenhouse gas levels are stabilized. The delay in reaching equilibrium is a result of the large heat capacity of the oceans.

Remaining scientific uncertainties include the amount of warming expected in the future, and how warming and related changes will vary from region to region around the globe. Most national governments have signed and ratified the Kyoto Protocol aimed at reducing greenhouse gas emissions, but there is ongoing political and public debate worldwide regarding what, if any, action should be taken to reduce or reverse future warming or to adapt to its expected consequences.

Global dimming, the gradual reduction in the amount of global direct irradiance at the Earth's surface, may have partially mitigated global warming in the late 20th century. From 1960 to 1990 human-caused aerosols likely precipitated this effect. Scientists have stated with 66–90% confidence that the effects of human-caused aerosols, along with volcanic activity, have offset some of the global warming, and that greenhouse gases would have resulted in more warming than observed if not for these dimming agents.

Ozone depletion, the steady decline in the total amount of ozone in Earth's stratosphere, is frequently cited in relation to global warming. Although there are areas of linkage, the relationship between the two is not strong.

Proposed system

Proposal for the utilization of waste energy of foot power with human locomotion is very much relevant and important for highly populated countries like India and China where the roads, railway stations, bus stands, temples, etc. are all over crowded and millions of people move around the clock. This whole human/bio energy being wasted if can be made possible for utilization it will be great invention and crowd energy farms will be very useful energy sources in crowded countries. Walking across a "Crowd Farm," floor, then, will be a fun for idle people who can improve their health by exercising in such farms with earning. The electrical energy generated at such farms will be useful for nearby applications.

Electricity is a basic need for everyone,But electricity reaches only 65% of the entire population and rest 35% still live in darkness in India 65% population also doesn't get continuous power supply and we still face power cuts to satisfy all the needs we need to produce 81,08,76,150 MW·h/yr,Whereas the production is only 60,06,49,000 MW·h/yr So we need 210227150 MW·h/yr to reach the demand. We need to think of an alternative to solve this crisis Presently there are many alternatives like solar , wind , tidal etc

3. Piezoceramic analysis

Man has needed and used energy at an increasing rate for his sustenance and wellbeing ever since he came on the earth a few million years ago. Due to this a lot of energy resources have been exhausted and wasted. Proposal for the utilization of waste energy of foot power with human locomotion is very much relevant and important for highly populated countries like India and China where the roads, railway stations, bus stands, temples, etc. are all over crowded and millions of people move around the clock. This whole human bio-energy being wasted if can be made possible for utilization it will be great invention and crowd energy farms will be very useful energy sources in crowded countries

In this project we are generating electrical power as non-conventional method by simply walking or running on the foot step. Non-conventional energy system is very essential at this time to our nation. Non-conventional energy using foot step is converting mechanical energy into the electrical energy**.** This project uses piezoelectric sensor.

In this project the conversion of the force energy in to electrical energy. The control mechanism carries the piezoelectric sensor, A.C ripples neutralizer, unidirectional current controller and 12V, 1.3Amp lead acid dc rechargeable battery and an inverter is used to drive AC/DC loads. The battery is connected to the inverter. This inverter is used to convert the 12 Volt D.C to the 230 Volt A.C. This 230 Volt A.C voltage is used to activate the loads. We are using conventional battery charging unit also for giving supply to the circuitry.

This project uses regulated 5V, 500mA power supply. 7805 three terminal voltage regulator is used for voltage regulation. Bridge type full wave rectifier is used to rectify the ac output of secondary of 230/12V step down transformer.

4. Installation and Results

The installation of the Piezo devices requires that flooring be removed. This process can be done as old, worn flooring is replaced or in certain high traffic areas as an experiment for determining feasibility in airport terminals, a similar option to the implementation in the Tokyo train stations. The Piezo devices, due to their small thin shape, could be placed underneath floor tiles or carpet with few complications. In order to harness the power a capacitor could be used to store the electricity like in the train stations or inverters, like ones used to convert solar electricity from direct current to alternating current, could be installed in the terminals to convert the DC power from the Piezo devices into AC power used in the lighting systems at airports. The power could then be routed directly to specific electrical devices such as lights or billboards or it could be sent to the main power grid at an airport in order to supplement the main power supply. There are many installation options and applications of these devices; the specific type of installation will depend upon the intended use of the Piezo devices within the terminals.

Locating Piezo electric flooring in airports is dependent upon how much traffic, on average, certain parts of a terminal receive in a given day; the higher the averages the higher the potential for energy production. Based on this it is important to locate high traffic areas to gain the most benefit out of the power generating floor. One such high traffic area is the check-in station, these areas often have large lines of passengers waiting to check in baggage and obtain boarding passes. Piezo devices could also be installed under the baggage weighing scales in the check-in areas to harness the energy from placing luggage on these platforms. Another high traffic area is the security line; the Piezo devices could be located under the floors along these lines to capture the foot traffic in these lines. Concession areas and advertising signs would also benefit from having the power-generating floor. Billboards could be light up by people passing by and lighting in the concession areas could be partially powered by the flooring. Experimentation with different areas and by observing locations of high foot traffic in airport terminals are important in determining the optimal locations for capturing kinetic energy from walking

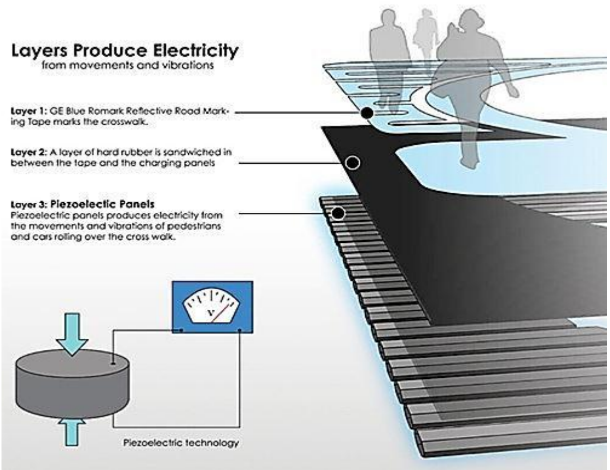

Figure 1: Step Design indicating layers

While the Crowd Farm wouldn't work in the home (a single human step generates only enough power to light 15 LED lights for one second), it could really draw some power from a crowd producing thousands of steps. And also it is found that for charging a battery of 6 volts 1.2 ampere hours it requires approximately 600 steps over the plate. The generated voltage from a piezoelectric material can be calculated from the following equation.

V = Sv * P * D

Where V = Piezoelectric generated voltage (Volts)
Sv = Voltage sensitivity of the material (Volt *meters / Newton)

P = Pressure (N/m2)
D = thickness of material (meters)
Voltage sensitivity values are provided with the material when received from the manufacturer.
Comparison of theoretical and practical results

S. No	Weight in Kgs	Theoretical voltage in Volts	Practical voltage in Volts
1	50	30	8
2	60	35	13
3	70	41	17
4	80	47	20

From the above tabular form it can be seen that the values of theoretical and practical values have large error this is because of the following reasons the plate designed is not formed with single piece it is formed by embedding circular discs in a 3*8 matrix with totally 24 discs each are separated by a finite space and for testing practical output it is seen that the pressure applied at two points of the persons foot hence the error between theoretical and practical values is large.

Conclusion

The proposed work **"**Electrical Power Generation through foot steps" has been successfully tested and implemented which is the best economical, affordable energy solution to common people. This can be used for many applications in rural areas where power availability is less or totally absent. India is a developing country where energy management is a big challenge for huge population. By using this project we can drive both A.C. as well as D.C loads according to the force we applied on the piezoelectric sensor.

Man has needed and used energy at an increasing rate for his sustenance and well being ever since he came on the earth a few million years ago. Due to this a lot of energy resources have been exhausted and wasted. Proposal for the utilization of waste energy of foot power with human locomotion is very much relevant and important for highly populated countries like India and China in future. And this can be implemented with little advancements which reduce the total cost and also reliability is increased.

We can connect a back up supply from grid so that in case of shortage of power we can charge the battery from the gird and next option is integrating the system with solar system and form a hybrid system such that the cost storage equipment is reduced and pure clean energy is produced with a high reliability.

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