Transfiguration of Vibration Energy into Electricity By "Piezo – Crystals"

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Abstract:

In general electricity is being generated by thermal, hydro, nuclear, and wind power plants by utilizing non- conventional energy sources which are inexhaustible. We experimented the conversion vibration energy into electrical energy using piezo crystals at different frequency rates. The energy produced in vibration system is known as vibration energy especially due to the vibration of atoms and molecules. There are numerous ways to produce vibrations. In this process we experimented with finger pressure. The output generated by piezo crystals is AC which is low. We amplified using RC coupled amplifier to high frequency then we converted into Direct current using full wave bridge rectifier. The converted is used to light up LED's in our project. In real world we can employee them in regions where huge vibrations are available such as Railway sleepers, metro stations, thunders, highways, sea shores. The output will totally depend on the frequency of input(vibrations) and direction.

I. INTRODUCTION

In the recent times, the most used form of energy is electricity but to how much extent it would be available? There are many ways to produce electricity from different sources such as Bio gas conversion, Solar energy conversion, Thermal energy conversion, Hydro energy Conversion, Nuclear energy conversion and many but all these have the drawbacks too. For example, in Nuclear energy conversion harmful radiation is emitted (Gama Rays). In the real world, vibration energy is being produced for each and every effect such as due to the motion of vehicles, sound generated by thunders, noise, etc. But the whole energy is being converted to heat energy which is not utilized. If we can make use of these vibrations and convert them to electricity, the production rate will be high. For this piezo – crystals are employed, these crystals has the ability to convert the mechanical stress to electricity. This means the change in the dimensions of the crystal produces the voltage. There are many piezo crystals which are naturally abundant such as Quartz, Berlinite, Rochelle salt, Sucrose, Topaz, Lead Titanate. The most used piezo crystal is Lead Titanate. The objective of this study is to convert mechanical form of energy to electricity. The major applications of piezo – crystals are detection of Sonar waves, sensors, strain gauges.

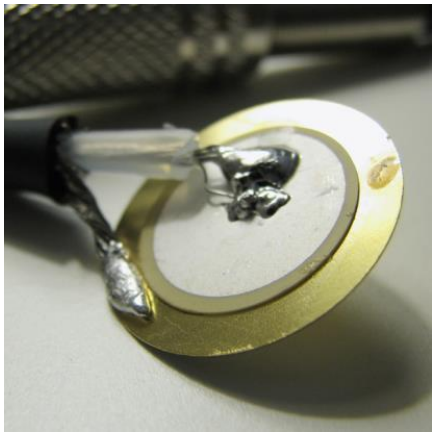

Fig (1): Piezo – Crystal

II. METHODOLOGY

This study used Piezo – electric crystals which are circular discs it has a positive and a negative terminal, positive terminal is situated on core of the disc and the negative terminal is situated on the centre of the disc we soldered the terminals and in the similar manner we connected nine piezo electric crystals in series. We placed them on aluminium plate. We made a protective layer for the aluminium plate containing nine piezo crystals. We placed the complete equipment under a door mat. The continuous vibrations are generated on it resulted in producing minute AC voltage, we amplified the resulting AC voltage using two - stage RC coupled amplifier. In fig (2) circuit diagram is mentioned.

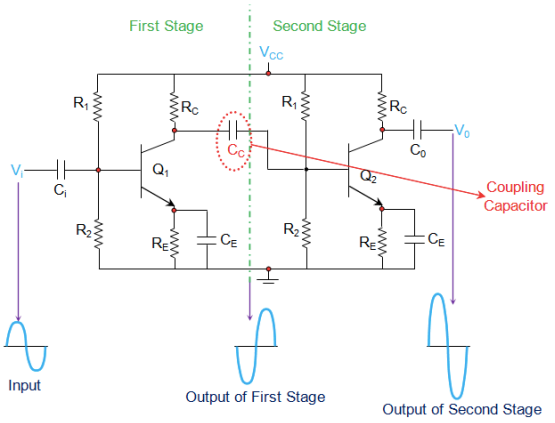

Fig (2): Two stage RC coupled amplifier.

Here, C_E is called bypass capacitor which allows only AC while restricting DC. The Coupling Capacitor C_c increases the stability of the network. At the first stage the input is amplified by making a phase shift of 180^0. And it is passed to second stage, at which the voltage signal is further amplified and shifted the phase angle to 360^0. In this way the output voltage is amplified.

Now the amplified voltage is converted to DC voltage using a full wave bridge rectifier. All the diodes in full wave rectifier are connected in series in pairs. In positive half cycle D_1 and D_2 are in series while D_3 and D_4 are reverse biased. During negative half cycle diodes D_3 and D_4 are in series while D_1 and D_2 are reverse biased.

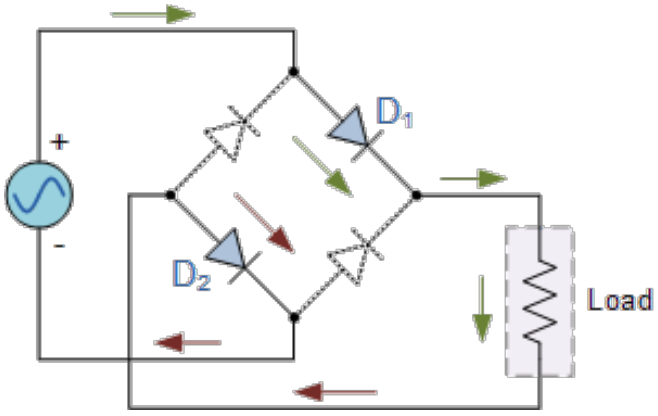

Fig (3): During positive half cycle.

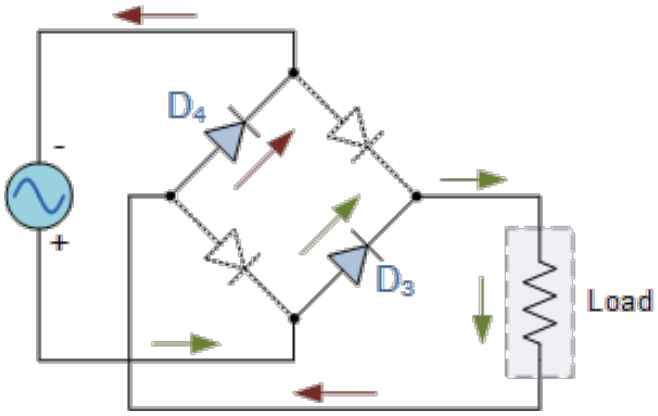

Fig (4): During negative half cycle.

The transformed direct current is used to lighten up few LED's as the vibration intensity is less the output is less.

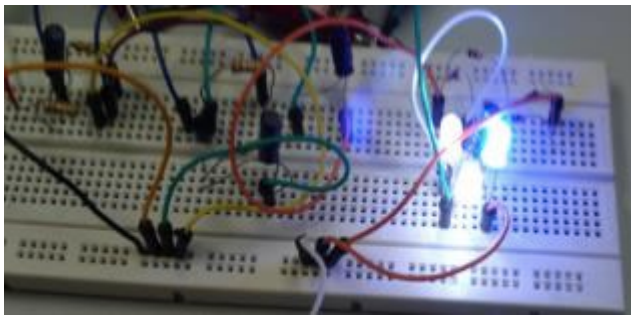

fig (5) : LED's connected to a bread board which are lighten up by piezo – crystals.

III. *RESULTS* AND DISCUSSION

One piezo – crystal is able to produce 0.8V so here we used 9 such crystals. The total voltage we gained is 7.2V and we amplified and converted into DC voltage which is around 10.18V. We connected the whole equipment to a bread board consisting of LED's. This proved we can convert vibration energy to electricity. The output voltage depends on shear effect, the charge generated is directly proportional to direction of forces applied. Equation is given by

$C_x = 2d_{xx}F_xn$ (for n elements).

d_{xx} gives the direction of force applied.

F_x gives the magnitude of force in that direction.

C_x is the charge generated.

The voltage generated will be different in different directions.

IV. APPLICATION AREAS

- Railway sleepers undergo huge vibrations where piezo – crystals can be employed in order to convert them to electricity.
- Metro stations has been generating huge vibrations by inward and outward of passengers in these regions we can make use of piezo – crystals.
- On the highways there will be continuous flow of vehicles which create vibrations.
- Sea shores, due to waves there will be some vibrations.
- During thunders there will be high intensity of vibrations which can be harvested.
- It's not only limited to above but, it can be applied in any of the areas where vibrations are available.

V. *CONCLUSION*

In this generation there is a sudden requirement of electricity but our resources aren't enough to fulfil the need. As per the survey the consumption rate is four times the production rate. To increase the production rate we can employee these piezo – crystals which literally convert mechanical form of energy to electrical. This study gives the appropriate solution for the production crisis in our country.

VI. *ACKNOWLEGDEMENT*

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VII. *REFERENCES*

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