Team Name: _Amigos_____

	Name	Branch and Semester	Contact Number	Email- ID
Team Leader	Nikil Chandrashekara	EEE,4th Sem	8296874007	nikchand1253@gmail.com
Member 1	Vidya J V	EEE,4th Sem	7619212582	vidyajv59@gmail.com
Member 2	Gokul Krishnan V	EEE,4th Sem	9483883916	gokulsudheer2000@gmail.com
Member 3	Mohammed Uwaiz	EEE,4th Sem	6366060293	mohammeduwaizmac123@gmail.com

CONVERSION OF SOUND ENERGY TO ELECTRICAL ENERGY USING HYBRID PIEZO ALTERNATING GENERATOR

Abstract

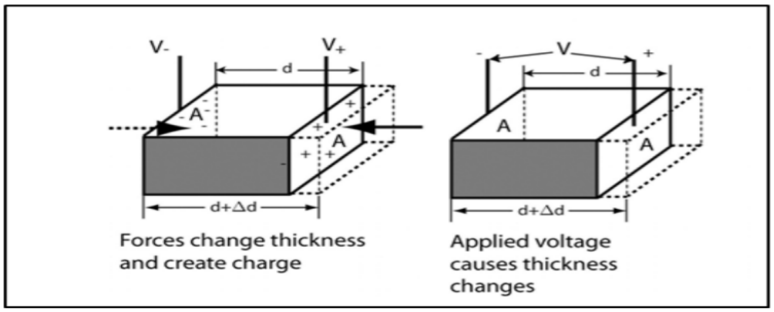
This model the work done on the conversion techniques and methodologies of converting sound energy to its electrical counterpart. The prediction of the future development of sound energy as a source is emphasized other than commonly known ones such as solar energy, biogas, wind energy and so on In this we are going to build a module using latest technologies that pull out the energy from the radiations that are being wasted .Though sound energy is abundant , the energy is being wasted and not harvested suitably. Previous studies have done this using piezoelectric and transducers. Our goal is to build an hybrid piezo alternating generator which even extract the vibrational mechanical losses of the vibrating diaphragm. The impact on power engineering will be huge if we can harvest sound and make it a feasible source of energy

Introduction

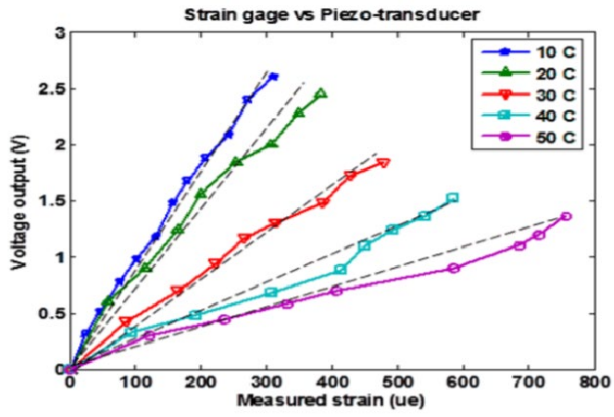
Due to huge scarcity of energy and exhaustion of fossil fuels, we are in search of renewable and feasible sources to produce electric energy. Renewable sources such as light and wind are widely used to generate energy. In similar fashion, if sound was utilized to generate energy, then the utility and applications would be enormous. We have sound all around us, In the modern world there is a lot of noise pollution in roads, airports, railway stations, industries ranging from 120 dB to 140 dB . If we can harness this noise and sound, then we can covert this energy into electrical energy and use it for daily uses.

Scientific explanation:

The way it works is that the mechanical energy of sound is applied directly to a crystal (or possibly a ceramic) with strong piezoelectric characteristics, and the crystal will generate a small amount of voltage in response to the application of that mechanical energy.



Piezoelectric ceramics are usually polycrystalline materials that are divided up into regions of similar polarization (domains). Once aligned, these domains produce a net polarisation. If an electric field is applied, the dipoles within the domains either contract or expand (resulting in a change in the volume). If a strain is applied, the dipoles are again forced to contract or expand, this time producing a potential difference.



Relationship between strain and voltage output of piezoelectric materials at different temperatures.

Literature Study:

1.https://economictimes.indiatimes.com//news/science/young-inventors-create-a-device-that-converts-noise-to-electricity/articleshow/71804623.cms?utm_source=contentofinterest&utm_medium=text&utm_campaign=cppst

In this model the device reverses the functioning of a normal speaker which vibrates to create sound when electricity is passed through it. It uses sound and converts it to electricity.

When sound waves hit the diaphragm of the speaker, the magnet and the coil inside interact thus creating electrical energy. This is then stored in a power bank which could power up light.

2.https://www.ijser.org/researchpaper/Conversion-of-Sound-to-Electric-Energy.pdf

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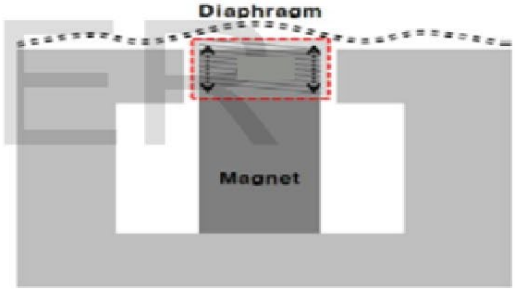
The second model of converting the sound to electricity is with the use of piezoelectric materials Lead zirconium titanate, Barrium, titanate, Zinc oxide. Electricity can be generated directly from sound energy by piezoelectric effect. The way it works is that the mechanical energy of sound is applied directly to a crystal (or possibly a ceramic) with strong piezoelectric characteristics, and the crystal will generate a small amount of voltage in response to the application of that mechanical energy (sound).

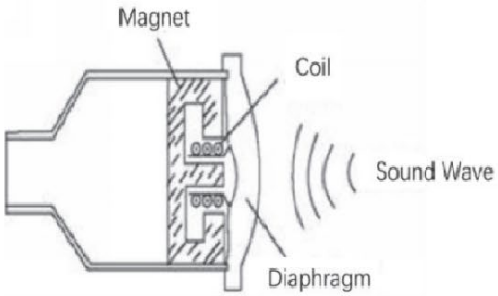
Motivation :

1. The first model uses the concept of vibrational mechanical energy by vibrating the diaphragm as one plate of a parallel-plate capacitor which produces electrical energy , but there is mechanical losses due to the vibration of diaphragm which reduces the efficiency of the model.
2. The second model used piezoelectric crystal. Losses in piezoelectric materials can be generated both mechanically and electrically. Loses such as mechanical losses, coupling loss and Dielectric losses are major in piezoelectric crystal; therefore the efficiency of the model is reduced significantly.

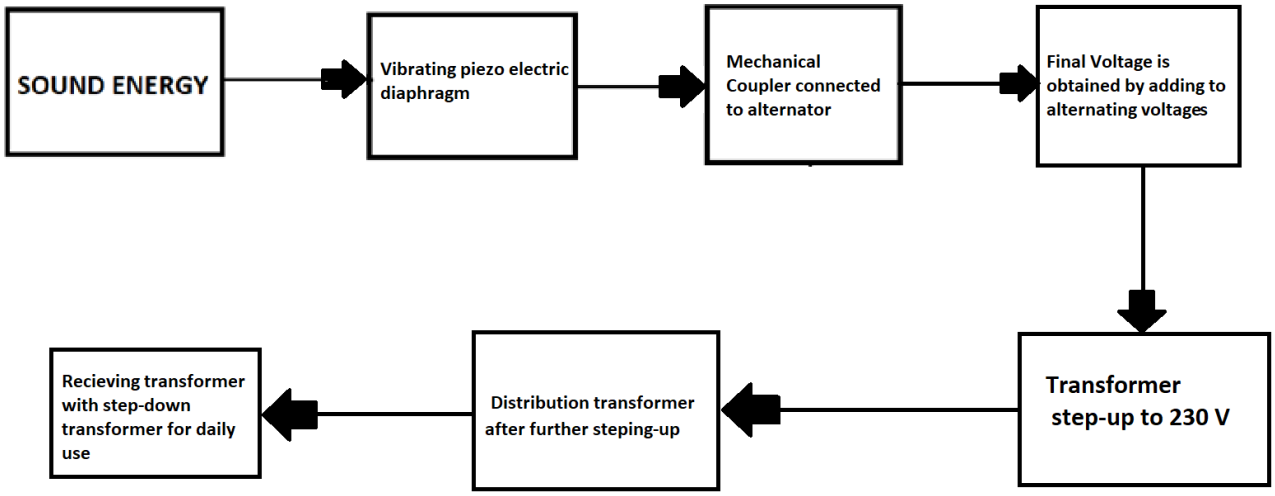
Therefore, from the above the two models we can conclusively say that If we are able to use harness this mechanical loss then the efficiency of the machine can be increased significantly.

In our model incident mechanical energy of sound is applied directly to a diaphragm made of piezoelectric material which vibrates and hence will generate a small amount of voltage in response to the application of that mechanical energy, now to increase the output and reduce the mechanical losses , a small coupler is connected to piezoelectric diaphragm such that the vibrating motion of the plate is able to rotate an externally isolated alternator (via the coupler) such that the vibrational mechanical loss is harnessed to produce voltage. Since both the outputs produced is AC we can add and step-up the final voltage and distribute it via the transformer.



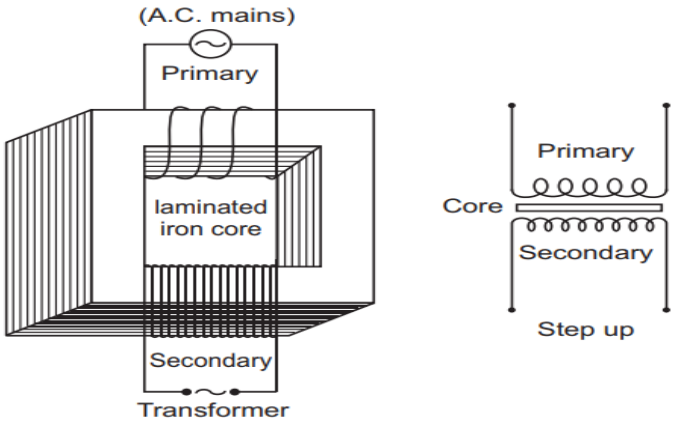


Methodology:



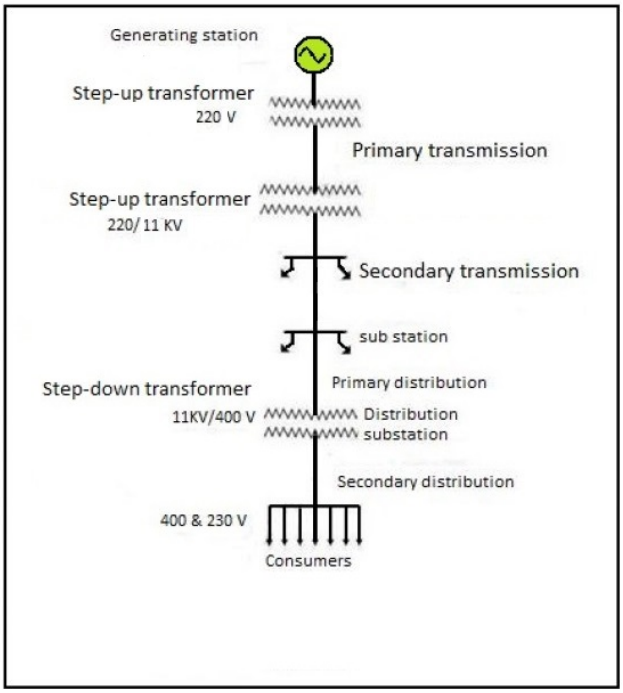
(Block representation of the model)

Transformer Circuit Diagram



Distribution

The output after stepping-up can be further stepped-up in distribution substations and can be distributed accordingly



Material selection

The piezoelectric materials that can be used to create a diaphragm are such as :

1.Lead zirconium titanate.

2.Barrium titanate

3.Zinc oxide

Scope Factor:

In near future if we can use this kind of energy then it will cause revolution in the field of the renewable sources of energy. Due to development of new sources like sound we can overcome the deficiency of electricity that we are facing in the developing countries across the world. Dr. Cohen-Tanugi from an interview claims that passing trains and subways aren't only loud, but their surroundings rattle and vibrate as they pass, and part of the thrill of a rock concert is feeling the whole auditorium shake. "There's a strong interplay between vibrations through the medium that you hear through — air or water — and the physical objects around you," says Cohen-Tanugi. "It's perfectly conceivable to absorb that movement and glean useable energy.

Though still in the research phase, such technology could mean a new era in energy generation and conservation. “Harvesting acoustic noise is more about mechanical vibrations than sound itself,” says Cohen-Tanugi. “The idea is definitely there, and it’s quite promising.

Social impact

We can lighten the street lamps and traffic lights just by extracting the sound energy of the noise that is produced by the vehicles on the road. In this way we are not only able to reduce the noise pollution and but also utilize it as a source of electricity. Also, in the industries with the mechanical forte where very huge amount of the noise is produced as result of functioning of heavy machineries this sound can be trapped and can be used to run the low power machines used in production process.

Conclusion

The sound energy is the unexplored source which has enormous potential to meet the future growing requirements of the electricity and serve as the eco-friendly and renewable source of energy. This technology is not practically usable up till now due to efficiency concerns but the present work on this field makes its future quiet promising