

Circuit for Converting Sound Energy's Pressure into Electrical Energy

Mr. Dhanaseelan Subramani, Mr. Kailash Senthilnathan, Department of ECE, SVCT,

Ms. Meenkashi Krishnaveni, Assistant Professor, Department of EEE, SVCT,

Dr. Lakshmi Subburaj, Professor, Department of ECE, SVCT.

ABSTRACT:

Power generation is most important thing in this world. This power generation is evolved from lot of updates with various methodologies. Present days we spend much amount of cost for power generation which causes the pollution in environment. Due to pollution and lack of resources we need to move on to renewable sources for power generation. We have known that we are having wind mill, solar panel, etc. are renewable energy sources, but they also much costlier. Our aim is we need to spend low cost and get proper efficient & regulated output from the design or sources. By the theme we proposed a solution to generate energy from sound waves. We design a circuit by using Acoustic meta material, piezoelectric transducers, step-up transformer, BJT 2N 3904, Bridge rectifier, capacitance, switch, chopper, a rechargeable battery. Here we use the principle piezoelectric effect, which converts mechanical stress into electrical energy when we apply mechanical stress to it and it converts the electrical energy into mechanical stress when we apply electrical energy to it. The existing methods were failed to give solution for induction of back- emf or reverse voltage in the circuit and also fail to give regulated output. We fulfill the failures which is occur in the existing proposals.

KEYWORDS: Power generation – pollution – renewable energy – sound waves→ electrical energy – piezoelectric transducers – step-up transformer – BJT 2N 3904 – chopper – back emf – regulated output.

Introduction:

The consumption of electricity was increased nowadays highly. Due to the high needs for human we use power by lot of ways for lot of purposes. Once upon a time the consumption of electricity was very low over India but now we can't live without electricity due increment of human needs as day by day. Power generation is became a backbone of a nation nowadays, because without power there is no any electrical and electronic appliances and without electrical and electronic appliance we can't survive easily. For power generation we use various methods like thermal, wind, nuclear, turbine, dynamo, etc.. But these methods are require more natural resources to make production of electricity in stations. Due to lack of natural resources we need to move on to the renewable sources of energy production. By the concept and cause of need we proposed a design to make conversion of sound waves into electrical energy. Our proposal works by the principle of piezoelectric effect and our circuit depends on law of induction, BJT transmission, and rectifying current source.

Existing proposals:

The existing proposals clarified that the piezoelectric transducers can convert the mechanical stress into electrical energy. But those papers and proposals not specified that how to give a regulated and standard or constant output. As a product our proposal should give proper output to store energy without any malfunctions. It was not followed in majority of existing proposals.

Literacy survey:

Hamizah Muhammad Salleh, Musli Nizam Yahya – e-ISSN : 2821-2835 [1] (<https://doi.org/10.30880/jsmt.2022.02.01.001>) . In this paper the authors design a circuit to convert sound energy into electrical energy by using components like BJT, microphone, IC 555 timer by without piezoelectric transducers or any piezo materials. The concept of this paper is using IC 555 timer to modify the pulse function into single wave as like unit step signal and using transducers convert the sound waves into electrical energy.

Jaehoon Choi, Inki Jung, Chong-Yun Kang S2211-2855(18)30844-9 [2] (<https://doi.org/10.1016/j.nanoen.2018.11.036>). The author explained about energy harvesting from sound waves briefly in this paper. The author also give brief summary with clear mathematical statements and ways of converting sound waves into electrical form. The summary help us to rectify our proposal errors.

Fatima Adam Imam – [3] (<https://ijisrt.com/assets/upload/files/IJISRT21OCT009.pdf>). The author explained briefly about the possibilities that how to design a generator by using piezoelectric transducers and BJT transistors. But the author can place full wave rectifier to got best solution and can avoid using multiple capacitance and BJTs.

Principles:

I. Piezoelectric effect:

The piezoelectric effect is the principle that converts mechanical stress into electrical energy when we apply mechanical stress to it and it converts the electrical energy into mechanical stress when we apply electrical energy it. Piezoelectric crystals which is made by silicon and germanium semiconductor

materials have a balanced charge with an asymmetric atomic structure.

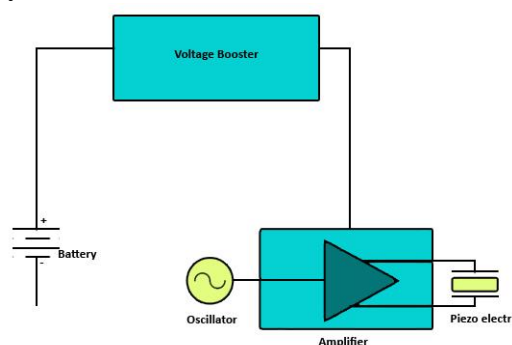


Fig. 1.0

II. Law of Mutual Induction:

The law of mutual induction state by Faraday is when a conductor is placed in a magnetic field which is varying condition, an electromotive force will induced. If the circuit is closed, a current will induce, and the current is called as induced current. We can step up and step down the current by make primary and secondary windings of transformers depending upon count of winding.

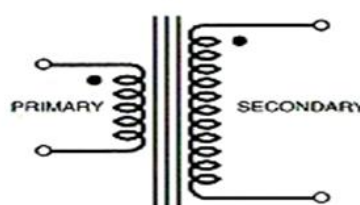


Fig. 1.1

III. Bridge rectifier :

In simple words we can say the work of bridge rectifier is converting the AC current into DC current to store it.

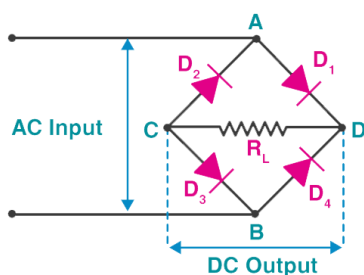


Fig. 1.2

Apart from existing proposals we propose solution to get step up and regulated DC output from the circuit. Our circuit design give a path for lot of power generating & storing products. And also by using our proposal we can assure natural energy production.

Our proposal:

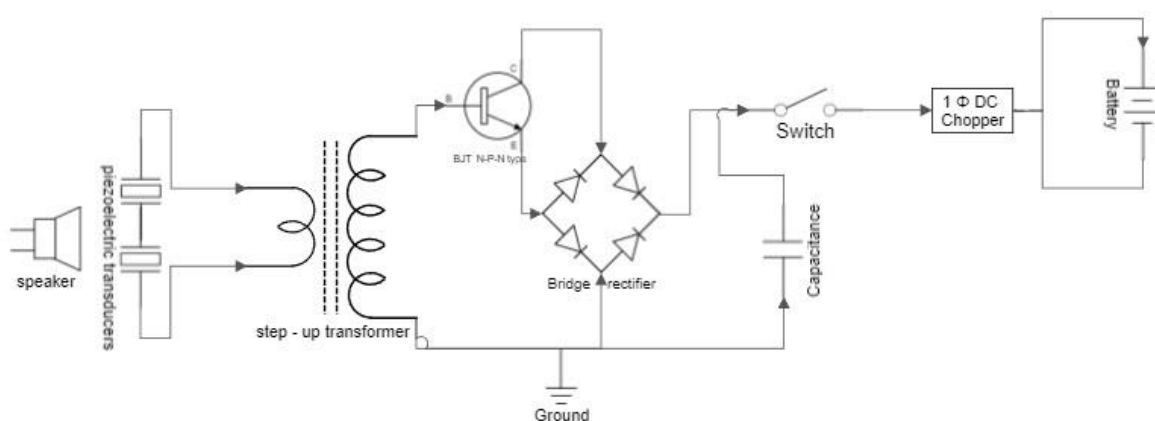


Fig.1.3 - Circuit design - sound waves / pressure into electrical energy

Working:

When the amplification of sound or normal sound is applied on before of acoustic meta material coated piezoelectric transducer, the cause of acoustic meta material the sound waves make a mechanical stress in the piezoelectric transducers. Due to the principle of piezoelectric effect, the transducer convert the mechanical stress into electrical energy by producing current.

The piezoelectric transducers constructed by place quartz between two electrodes, after applying dynamic force (mechanical stress) the quartz producing the current.

The current produced from piezoelectric transducers is basically AC current and that current

will allowed to step- up transformer to step up the AC current without changing frequency. The storage of AC current is not possible therefore we need to convert the AC current into DC current. For the reason our circuit contain Bridge rectifier to convert the AC current into DC current which produced from step-up transformer.

The output DC current connected with single phase DC chopper to make the unregulated DC into regulated DC which is able to store it on the battery.

This circuit having possibilities to produce back / reverse voltage by the cause of closed circuit and continuous connection. To avoid the reverse voltage induction I place BJT 2N 3904 transistor (n-p-n type) to avoid induction of reverse voltage in the

circuit. Reverse voltage occurs when the connecting source of the energy signal to the circuit is applied in an inverted manner. For suppress this we need to apply high voltage as higher than induced voltage at secondary side in transformer. For the reason we place BJT transistor in this circuit, because the work of BJT is give output higher than input current. In the BJT transistor there is three terminals namely Base, Collector, Emitter. In BJT Base and Collector get input current and Emitter emits the output. The Formula for $I_E = I_B + I_C$.

Our aim:

Based on the principles law of mutual induction, piezoelectric effect, work of rectifier and work of rechargeable battery to design a device without violate the circuit Fig. 1.3. And make our device, sound harvesting power generator as a product and make our product available in the market. The dependency of present electrical energy supply should decrease in future. From this prototype design the alternative power generating methods should be boosted.

Analysis of Input and Output of design:

Si. No	Input (db)	Input (v) for step – up transformer	Result (V)
1.	20	0.03 V	17.8 V
2.	80	0.61 V	27.9 V
3.	82	0.92 V	33. 8V
4.	85	1.3 V	98 V
5.	90	1.9 V	120 V

Results:

By the analysis we can conclude that the piezo electric transducers are good electric generator by getting input as sound. Also the piezo electric transducers can convert the pressure as electricity which is tested here. By our testing we give the result that piezo electric transducers can convert the pressure into electrical energy that pressure may be man made or artificial like we give pressure by giving input as amplified sound.

Conclusion:

There are many sources of noise that go unnoticed. One of them is the noise of vehicles in urban areas. We demonstrates that noise can act as an alternative source Energy. We know that how the electricity that generated by polluting the environment (thermal, nuclear, etc.,) and transformed in many stages to reach the consumers. By using this idea of our proposal we can get regulated DC power as output and can store it a

battery and we can use it for charging our electronic appliances. This will take long time to reach renewable energy production but we should encourage this initiatives too for make our environment non polluted.

Future Prospects:

The growth of nano technology was marvellous. The alternative source for piezo was developing now. If the idea of converting sound into electrical energy got succeed, the TRIBO ELECTRIC NANO GENERATOR (TENG) will leads the power generation by getting input as pressure or sound energy also it was most efficient that piezo transducers.

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