Finding an Alternative Method to Convert Ambient Acoustic Energy to Electricity

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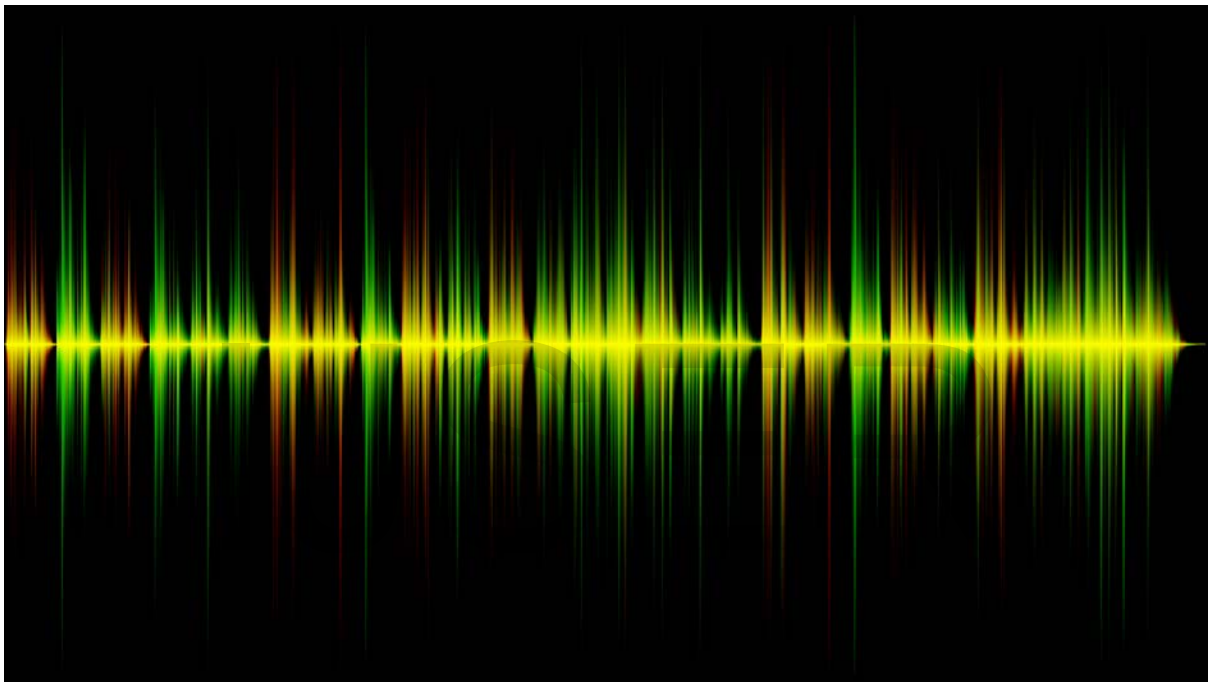
Abstract — This paper presents an alternative mechanism to the conventional method of converting ambient acoustic energy to electric energy. The proposed mechanism produces alternate current by harnessing the energy of background sound waves which can be converted it into direct current to be used by an electronic device. The proposed mechanism can remove the limitation of portable devices having to carry primary cells and provides an environment-friendly manner of using acoustic waves for energy production. Furthermore, it reduces the intensity of ambient acoustic waves and hence reduces noise pollution.

Keywords— Acoustic Energy, Acoustic Lens, Alternate Current, Electromagnetic Induction, Piezoelectric plate, Noise pollution



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Introduction

The use of energy has been a key in the development of the human society by helping it to control and adapt to the environment. Managing the use of energy is inevitable in any functional society. The development and exploitation of energy resources has become critical and its consumption is a measure of the advancement of human civilization. Most of the world energy production takes place using non-renewable natural resources such as crude oil and coal and as the world energy consumption increases every year, these resources come under a greater threat of depletion.

Most of energy production consists of converting one form of energy into an alternate, more useful form. Whenever such a process takes place, a portion of the energy gets dissipated, the amount of which depends on the efficiency of the conversion process. As the energy demand of the world increases year by year, it is essential that we develop technologies than enhance the efficiency of our utilisation of non-renewable natural resources.

Furthermore, when dissipated energy causes problems like noise pollution for the entire society, it becomes all the more vital to formulate technologies to put this lost energy to use where feasible. This is the motivation behind my proposal of a mechanism to produce energy using non-directional background sound waves and hence reduce noise pollution.

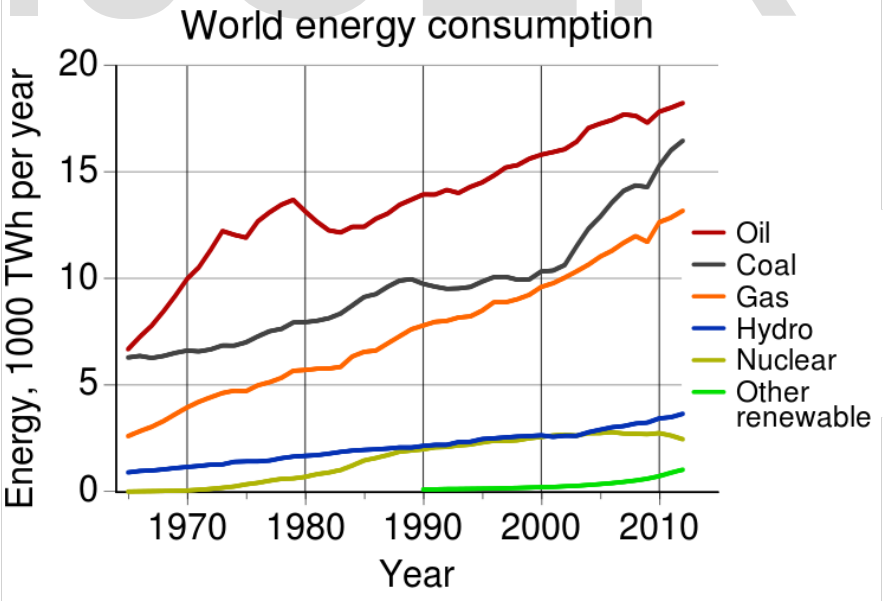
Materials, Design and Principle of Working

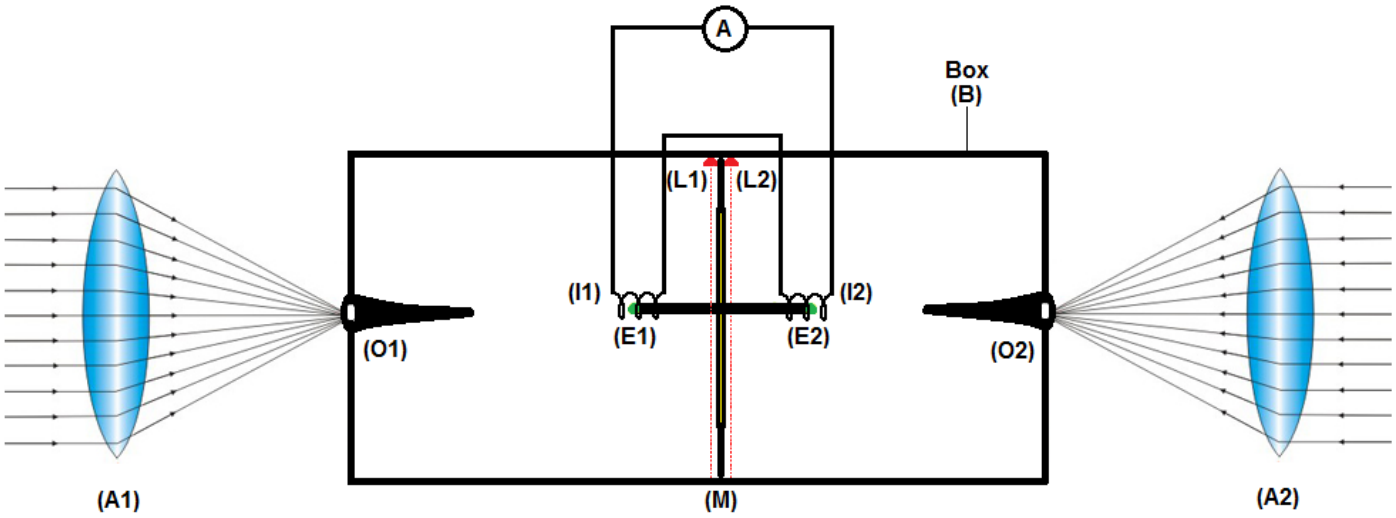
The basic materials required for building a prototype of this mechanism are:

1. Acoustic lenses
2. Thin polyisoprene membrane
3. Airtight Box
4. Inductors
5. Ammeter
6. Light permanent magnet
7. Piezoelectric plates
8. Supporting Wires
9. Lasers

Elementary Principle behind the Working

- Faraday's law of Electromagnetic Induction
- Lenz Law





The Basic Setup

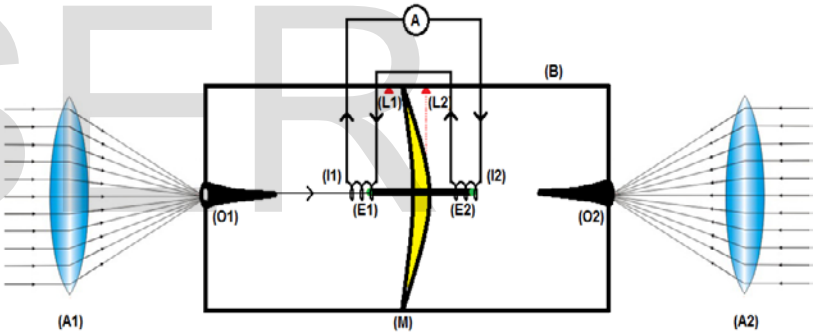
An arrangement of identical converging acoustic lenses, (A1) and (A2) attached on airtight box (B). Two curved conical tubes with small inner openings, (O1) and (O2), with outer openings facing (A1) and (A2) are located on opposite faces of (B) at a distance equal to the equal focal length of (A1) and (A2). Inside the airtight box is an isoprene membrane (M) with piezoelectric plates (E1) and (E2) attached to a permanent magnet on each side respectively. (E1) and (E2) are located partially within inductors (I1) and (I2) which are connected to an ammeter with conducting wires. Lasers (L1) and (L2) are connected close to (M) within (B). If the distance between (E1) and (O1) is denoted by 'd', and the speed of sound in air by 's', the distance between (L1) and (M) is given by:

$$D = d/s$$

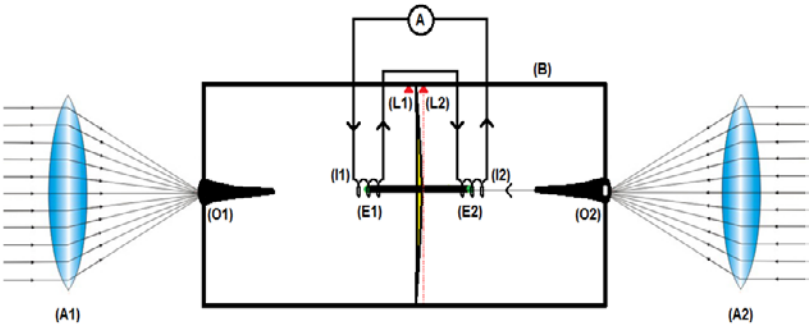
Mechanism

Step 1: In an ambient acoustic background, all parallel sound waves incident on the lenses (A1) and (A2) are converged to its focus. Initially, both (O1) and (O2) are closed and (L1) and (L2) are switched on.

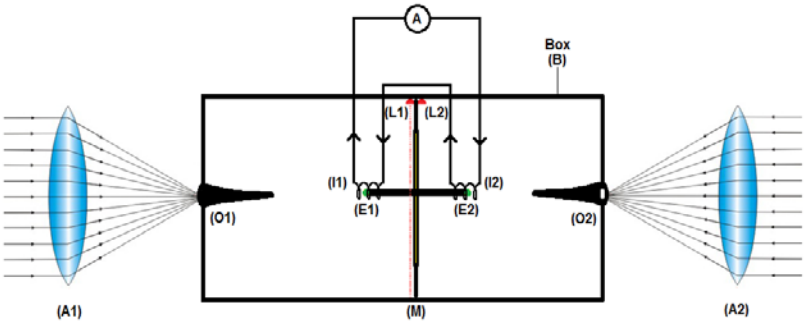
Step 2: As (O1) opens, converged sound waves get reflected multiple times on the inner surface of the curved conical tube, and a unidirectional sound wave emerges from its small inner end. When a complete compression and rarefaction is encountered by the piezoelectric plate (E1), (L1) is switched off and (O1) is closed. A potential difference is generated across the ends of the plate due to pressure applied by the wave. The membrane (M) vibrates with the remaining energy of the sound wave and moves towards (O2) blocking the path of laser (L2). The increase and simultaneous decrease in magnetic flux in (I1) and (I2) respectively, induces an electric current by Faraday's law of electromagnetic induction in clockwise direction in the circuit, according to Lenz law and the ammeter shows the required deflection.



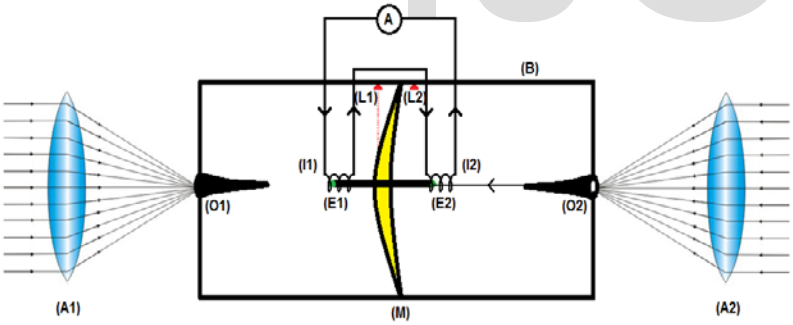
Step 3: The membrane moves back towards its mean position after stretching completely. As soon as the path of (L2) is reestablished, (O2) is opened as this switch takes place and another sound wave is directed towards (E2).



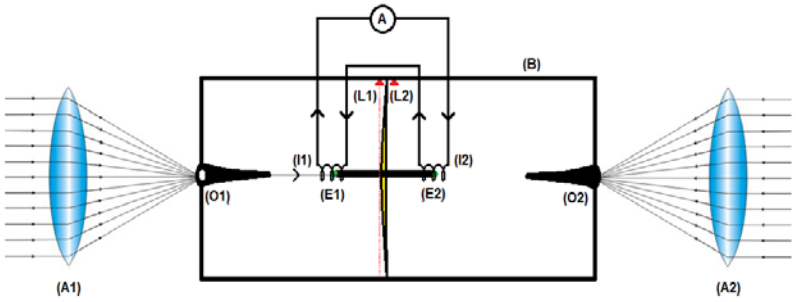
Step 4: (O2) opens and converged sound waves get reflected multiple times on the inner surface of the curved conical tube, and a unidirectional sound wave emerges from its small inner end. When a complete compression and rarefaction is encountered by (E2), (L2) and (L1) are switched off and on respectively, while (O2) is closed. The sound wave is incident on (E2) exactly when (M) is at its mean position.



Step 5: The sound wave incident on (E1) generates electric potential across its two ends. The membrane (M) is at its maximum velocity at its mean position, and the residual energy of the sound wave adds to it. The membrane (M) moves towards (O1) and blocks the path of (L1). The direction of the induced electric current is reversed.



Step 6: The membrane after stretching completely, to an increased amplitude, moves back towards its mean position. As soon as the path of (L1) is reestablished, (O1) is opened as this switch takes place and another sound wave is directed towards (E1).



Step 7: The whole is repeated perpetually. Each cycle will correspond to an increased amount of induced electric current till static amplitude is established.

The airtight box prevents stray sound waves from entering the device and switching (O1) and (O2) ensures that sound waves only increase the amplitude of vibration of (M). The number of turns in (I1) and (I2) can be increased to increase the magnitude of induced current. An alternating current with the frequency of oscillation of (M) is obtained. The given circuit and piezoelectric plates can be connected and the current can be converted into DC for usage by a device.

Advantages of the Proposed Mechanism

1. The proposed mechanism increases efficiency of the previous sound to electricity conversion process.
2. It can be readily used to power portable devices or can be set in noisy areas to reduce the intensity of the acoustic background i.e. reducing noise pollution while producing usable energy.
3. It is an environment friendly process to produce electricity and requires low maintenance.
4. This device can increase the effectiveness of sound proofing materials.

Conclusion

Sound energy can be efficiently used to for electricity production while solving the problem of noise pollution in modern cities.

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