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Prospect of Electric Generation Using Sound

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Abstract. Noise is also an important energy, but has been controlled for its harm. If noise can be made effective use of at the same time, there would be a large change in social life. Based on studies on converting sound to electricity over the years, some effective implements of electric generation using sound are put forward for the new situation of utilizing of noise.

INTRODUCTION

Noise is one of 4 environmental pollutions. There is much of improvement in air pollution and water pollution while little in noise pollution in developed countries. Noise pollution will be the main pollution problem in 21 Century under the circumstances. The World Health Organization (WHO) considered that noise would affect one's mental state and quality of life. For example, noise of industrial production is harmful to workers' health due to its very high sound levels and environmental noise disturbs people's work, study, daily life, relaxation and sleep, affecting people's mental state, thus it is of much importance to make the noise under control and useful.

DEVELOPMENT OF NOISE UTILIZING

Previous studies on noise are primarily to control and absorb noise. In recent years, a certain amount of research on noise has been conducting all around the world. For example, dust removal via noise ^[1], noise weapons, noise hypnosis, noise weeding, noise diagnosis, measuring temperature via noise, noise refrigeration and so on. Chinese researchers have also gained remarkable achievements in sound energy application, such as the ultrasonic machining, weld bead cleaning, dust removal and thermoacoustic refrigeration technology ^[2] and so on. But as to noise generation, it is still in research phase.

DEVELOPMENT OF ELECTRIC GENERATION USING SOUND

In recent years, the study of electric generation using sound is in the process. On the one hand, with the development of industry and agriculture, energy crisis threatens the world. On the other hand, noise pollution is being paid more and more attention to. Therefore, to convert noise into electricity will kill two birds with one stone. Chinese researcher Zhanghua Wu, who is from Technical Institute of Physics and Chemistry CAS, developed a hundred-watt traveling-wave thermoacoustic generator prototype ^[3], which is a sound energy power generation equipment. Iranian researchers ^[4] invented acoustic-electric technology. University of Utah scientists developed a miniature thermoacoustic generator that can turn heat into sound waves, then into available electricity.

Noise is a kind of acoustic energy and noise pollution is also a form of energy pollution. When the sound intensity reaches a certain level the noise can be exploited. For example, jet can produce noise of 160dB, which power reached 10000W. Large blowers can produce noise of 140dB, which power is 100W. Energy of car noise and stereo sound noise is also very large, thus there are possibilities of energy absorption and utilization. The problem is how to convert this low grade energy to high grade energy. If using acoustoelectric transducing materials, the energy can be collected and converted into electrical energy. Experiments have shown that this is feasible.

An experiment of acoustic-electric transition^[5] as shown in Figure 1 (a), a piezoelectric ceramic piece of area S , which is polarized, is in series connection of ammeter and oscilloscope through two wires educed from its both polarized sides. When sound pressure is applied in direction of polarization, the signature will be indicated by ammeter and noise waveform will be displayed on oscilloscope's screen (Figure 1 (b)). Using the value indicated by ammeter and the voltage amplitude of the waveform on the screen, the amount of electrical energy that is converted by the piezoelectric ceramic piece of area S can be calculated. In addition to the magnitude and direction of noise, the amount of converted electrical energy depends on the area S of the transducing material, sensitivity and amplitude characteristics.

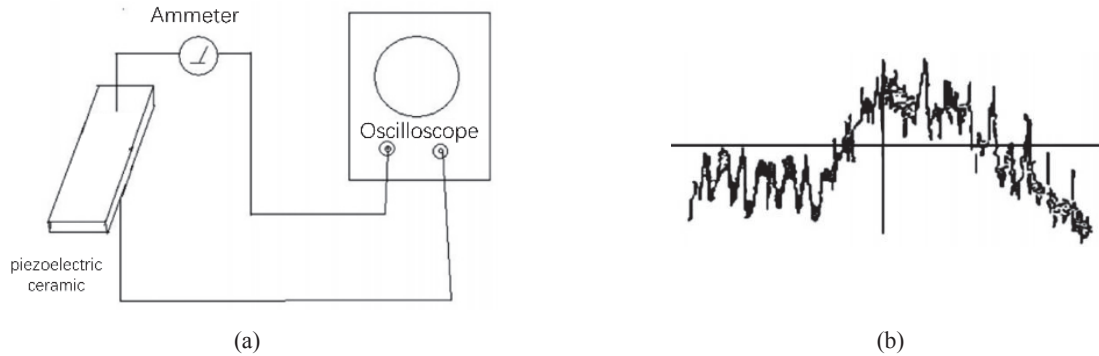


FIGURE 1. (a) Electrical test equipment. (b) Noise waveform diagram

According to the characteristics of noise and electricity researches can be done in many respects.

Artificial Lithium Niobate Crystal

In many research scientists found the material of artificial lithium niobate could convert sound to electric under the condition of high temperature and frequency. When sound waves encounter such materials, the sound energy will be converted into electrical energy. However, only under the condition of high temperature and frequency does it work. British scientists designed and manufactured an acoustic receiver of membrane type according to this phenomenon. Connecting the receiver to the resonators which aims to gather and amplify sound energy, it can produce electricity.

Lead Zirconate Titanate Ceramic

Lead zirconate titanate ceramics^[5] does not work in such conditions of high temperature and frequency like lithium niobate crystal. It is one kind of piezoelectric ceramic. The material itself will produce the accumulation of charge under the pressure, which is called the piezoelectric effect.

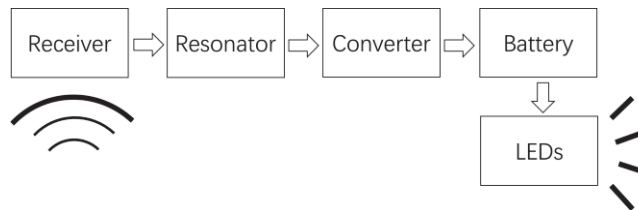


FIGURE 2. Noise powered lamp.

A noise powered lamp with this material can works in daily life. It consists of an acoustic receiver of the diaphragm, a resonator aiming to gather and amplify sound energy, a converter of piezoelectric ceramic, a battery and LEDs. When acoustic energy from the resonator acts on the receiver, it can generate electricity. The lamp can convert acoustic energy to electrical energy and charge the battery in daytime while light at night (Figure 2).

Principle of Condenser Microphone

Similar to condenser microphone, the device consists of a thin metal diaphragm and a metal electrode extremely close to metal diaphragm. Metal diaphragm and metal electrode are insulated mutually and compose a capacitor. In order to compensate for the pressure changes, a small hole is punched on the microphone wall (Figure 3). When the microphone is exposed to the sound field, the path will be affected by an alternate force, which is directly proportional to the sound pressure and the diaphragm's area. Due to the movement of the diaphragm the capacitance changes. The change can be transformed into an alternate voltage signal, which realizes acoustic-electric transition. The energy can be stored in battery with wires connected to two poles.

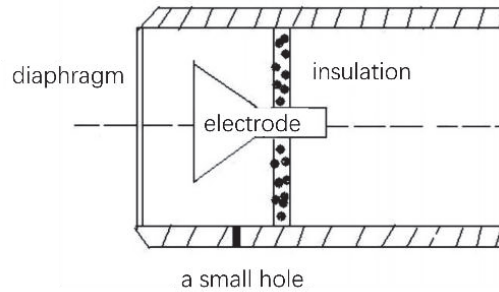


FIGURE 3. Condenser Microphone

Principle of Moving-coil Microphone

Similar to moving-coil microphone, it relies on electromagnetic conversion. When the coil moves in the magnetic field cutting the magnetic induction line, it will produce the induced voltage. The coil is connected to diaphragm. When the sound waves makes sound diaphragm vibrate, the coil also vibrates. Then electricity is produced and can be stored.

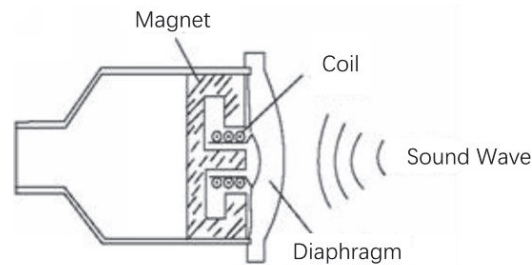


FIGURE 4. Moving-coil Microphone

Practicality

With the development of technology, the electricity consumption of some appliances rapidly declines. For example, the LED is of the same brightness of the incandescent lights but the only 1/10 electricity consumption. In future, electricity consumption may decrease, the possibility of noise generation may increase. Traffic noise, due to its instability of frequency, can be converted to electricity with resonance. The electrical energy collected can be used for road-lighting at night. The converter can be made in the form of roadblocks along the highway. Industrial noise, which are usually of stable frequency, receivers can be made into special shapes required to collect acoustic energy.

SUMMARY

Noise generation will be increasingly possible on the basis of complete theories and continuous development of new transducing materials. With the development of industry and transportation, new noise pollution is emerging, forcing technologists not only to try to remove noise originally but also to control noise on transmission. If the controls can be combined with recycling, it is not only a major breakthrough in pollution control but also a supplement for human's energy. The application of this technology has not been familiar to public and some aspects is not perfect. There still are questions of costs and benefits waiting scientists to resolve, making this technology more perfect and more possible. There have been some achievements in some countries and noise generation is expected to be a new situation.

REFERENCES

1. Bai Xiaoqing, Zhang Jianghui. Recent research progress of application of sound environmental protection. Energy-saving,2001(8)
2. Wu Zhanghua, Luo Ercang, Dai Wei. Study on thermoacoustic theory of linear generator of power. Solar Journal,2008,29(4)
3. Song Deling, Zhao Li, DuYanhong. Feasibility of noise energy conversion and utilization. New energy, 1997 ,17(12)
4. Li Wann, Zhang Jing, Wang Longyu. Noise generation. Ecological economy,2004(2)