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USE OF DAILY ENERGY LOSES IN GENERATING ENERGY USING PIEZOELECTRIC

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Abstract - **With the advent of the very need to explore the non-conventional sources of energy due to the lukewarm presence of the energy sources that are conventional in nature, we have come across to the might of the piezoelectric substances. Albeit, a lot of practical work has already been done in this field there were a few rooms left some of which are being dealt with in this paper. The use of the noise pollution especially in the areas of heavy traffic, the use of the powerful vibrations by the trains' motion beneath the railway track itself, the use of the energy of the rain drops falling on the ground, the use of the energy lost while typing on a keyboard of a laptop & moreover, using the combustion engines.**

Index Terms: **Piezoelectric, Internal Combustion (IC) Engines, Tidal, Tourmaline, PZT, Quartz, PVDF.**

I. INTRODUCTION

The piezoelectric substances are the materials that do interact with the external physical properties like Pressure, strain or force, on the grounds of the Piezoelectric Effect, which was proposed by Pierre Curie in 1880. Under the Piezoelectric effect, an external application of force is allowed onto the considered material which results in the deformation of the material(or the crystal) that further results in the change in atomic or electronic positions within the crystal, as a consequence of which the net dipole moment is built in the crystal of the piezoelectric material. Consequently, the polarization of the charges culminates in the net Electric field intensity within the crystal which further results in the motion of the electrons in the direction of the electric field developed. This electron motion then contributes the output voltage, as shown in the fig1. The force can be either compressive or tensile, output voltage will be obtained in both of the cases, as shown in the fig2.1. On the basis of the direction of the applied force there are three effects- Longitudinal,

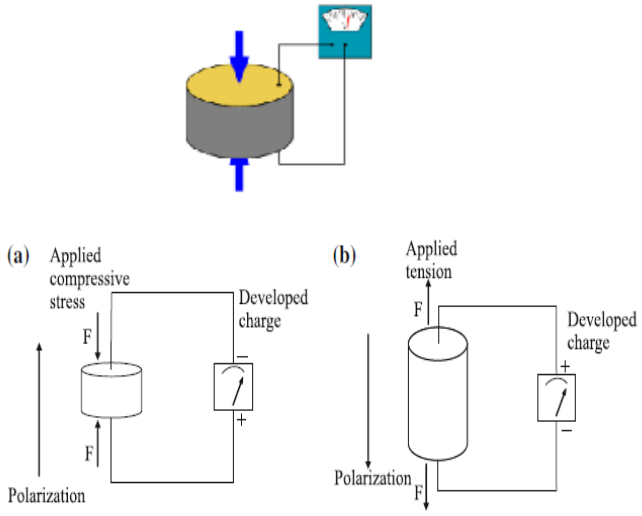


Fig. 2.1 Direct piezo-effect: a at applied compressive stress, b at applied tension

1. On the application of force on the piezo crystal voltage output is obtained

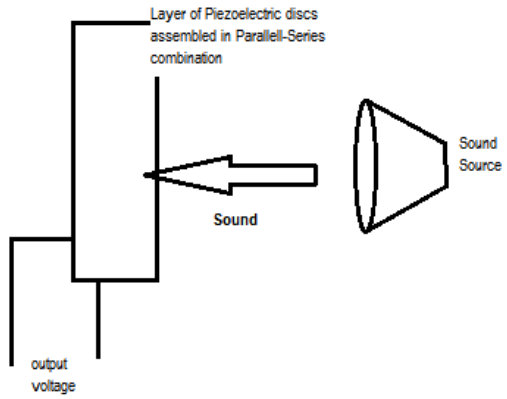
Transverse & Shear effect- which define the amount of charge. As a result, Transverse effect is the most preferred one as in this the amount of charge depends upon the applied force in the Y- direction & the dimension of the crystal element. The deformation of the crystal element of the piezoelectric substance is of the order of micrometer that makes it ideal for the tiny motion detection. The naturally available piezoelectric substances are Quartz, Gallium Phosphate & Tourmaline, while PZT (Lead Zirconate Titanate) & PVDF (PolyVinyliDene Fluoride) & etc, are the synthetic ones. On an estimation, *a force of 2000N-on the Quartz crystal of 1 cubic cm- gives the output voltage of 12.5kV. In simple words, 1N corresponds to 6.25V of output voltage*, for the provided crystal. On the above basis, we have devised some new areas where the daily energy losses can be utilized for the generation of useful energy in the form of electrical energy.

II. Using the Noise Pollution

With the increase in population and the consequent outburst in the number of vehicles on the road, there is a huge spate in the quantity of the noise pollution. As a result of the mentioned fact, we have devised to use the generated noise – like from the blown horns – to convert it into the electrical energy by the use of the piezoelectric transducer unit that is forged by electrically parallel connection of several rows of the piezoelectric
discs that are connected- in a fixed number- in series in each row, for instance as shown in fig2.

2. Parallel & Series connection of piezoelectric discs

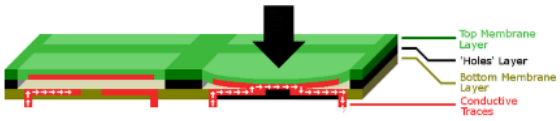
For the experimental purpose, we have used a Piezoelectric speaker that was allowed to connect with a voltmeter through its electrical terminals, to record the output voltage. In the input of the Speaker used (the end from where we generally obtain the sound), we provided the Noise from the traffic (or from any experimental sound source). The amount of voltage obtained
clearly depends upon the sound quality in decibels. The voltage output of the order of mV
is obtained for the application of sound in range of 80-100dB. For an increased the output voltage, amplification could be done at any of the feasible ends – either the amplification of the voltage or the amplification of the sound or both for much better results. This prototype works as the sound is applied at the speaker end the piezoelectric material's layer gets vibrated or gets deformed which further results in the voltage output. In the practical arena, instead of the piezo speaker we might use an ingeniously forged tile like structure that would as a whole work as piezoelectric layer giving the maximum possible output. The layer would be equipped with the maximum possible piezo discs connected in series in maximum possible rows, all of which will be connected in parallel (as shown in fig2)- for the best possible output, as shown in the fig3. This technology can also be used in places where the sound level is, normally, higher than the level of 120dB – like in parties and all.



3. Schematic setup for large voltage output

III. Self Charging Device, Laptop

In order to make the devices immaculately independent of external power sources or self chargeable facets are being explored. So we does, we have devised a way in which we can render a laptop as a self – charging electronic device.



4. The three layers of a Membrane Laptop (3 Layers: Top membrane, Holes layer, Bottom membrane; & conductive traces)

A layer of the piezoelectric material of the desired & suitable dimensions is incorporated between the top membrane & the bottom membrane layers, i.e., in the region of the holes layer – an empty layer which keeps the key open, when not pressed. By the insertion of this piezo layer - of desired material like PZT - on the application of the pressure by the user, the top & the bottom layer tend to meet, to complete the circuit of the conductive traces. This will result in the application of the requisite pressure on the piezo layer inserted which would result in the output voltage that would be fed to the chargeable battery of the laptop. There is no need to hardly press any key due to the new inserted layer as it entails the deformation in the µm range. Also, the new inserted layer would act as a dielectric with its dielectric constant 100 times that of an ordinary one (making the capacitance 100 times of that with air as a dielectric). This would result in the demand of a very low voltage supply for the conductive circuit, and in-turn would save a considerable amount of energy and

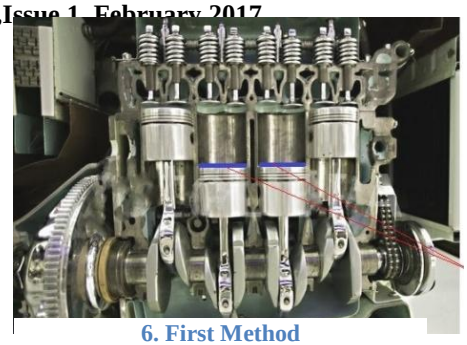
thereby, rendering the device efficient. A similar approach could be made for the conventional keyboards of the laptops. In this, beneath each key could be connected a piezoelectric crystal (or disc) of the suitable dimensions which could be allowed to connect to an amplifier (demands a very low power) leading its output voltage to the rechargeable battery.
For enhancing the force on the singly deployed crystals, beneath each key, a tiny spring of considerable spring constant can be installed right in between the key- hammer & the head of the piezo crystal. This would, certainly, enhance the voltage output of the crystal of the fixed dimensions.

5. Schematic representation of the incorporation of a spring in between

The technology that was proposed for the membrane keyboard, above, can also be used be used in the touch screen equipped devices like Smart Phones, Tablets, touch screen Monitors equipped with the rechargeable battery, by incorporating a thin layer in mid of the main screen & the capacitive layer which would certainly result in the piezoelectric effect.

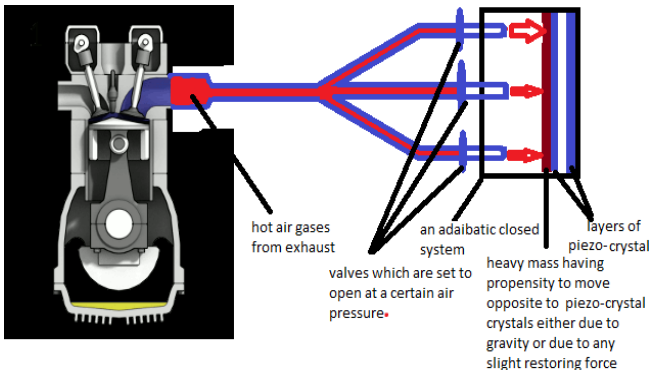
IV. IC Engine Application

Internal combustion engines though are used to run automobiles but are of a huge source of energy which has not yet been harnessed. In other words, millions of watts of useful energy is dissipated every day. IC engines are capable of doing much more than merely running a automobile and this aspect of energy generation by using IC engine must be explored as soon as possible as day by day the energy needs are soaring and we are in no stand to waste any source of useful energy. So, with this ardor we came up with an idea of harnessing dissipating energy of IC engine so that it could be used for any constructive purpose.
Here, we know that in four stroke petrol engines there are four strokes constituting two cycles and also, we are well familiar with the fact that the motive power is generated in only one stroke. This means that the energy developed in remaining three strokes is dissipated as heat energy or some other form.



6. First Method

In statistical terms,
Let's consider the diameter of bore of the engine to be, say, 4 inches (practically, it remains between 2.5 to 4 inches for normal, a thousand cc car)
Since the piston is 4" in diameter, the top surface of it is just PI * (4/2)2 or around 12.6 square inches. Each of those square inches experiences the 500 PSI (G) pressure (Pascal's Law), so the total force then instantaneously applied to the top of the piston is 12.6 * 500 or around 6300 pounds.
This force in terms of Newton would be: `6300*4.44822162 N = 27,720 N`
Such a huge amount of force and hence, energy is wasted in order to achieve only one stroke of useful energy. Similarly, heat energy is also dissipated in huge amount so, to harness both forms of the dissipated energy, we have hypothesized the use of special category of piezo-crystals (which are efficient in pyro-electricity, too) in the IC engines.
The two methods of implementation of piezoelectric crystal in the IC engine are-
The First (fig6) is the direct implementation of piezo-crystal on the piston's top in order to harness both heat energy and energy due to compressive force applied on the piston.
The Second (fig7) one is the substantial arrangement done to achieve the same.



7. Second Method

The basic difference between both of the arrangements is of contact. The first one is in direct contact in order to harness as maximum amount of energy as possible but it might damage the crystal as it is subjected directly to very intense pressure and temperature. And also, the first method of implementation is demarcated by the complexity of wiring and connections.

Whereas the second method is however less effective but is simple and free from hazards. Although, it increases the size of engine by an iota amount but it is more stable system where both the characteristics of piezo-crystal (pyro- and piezo-) can be subtly utilized in an effective manner.

This is an effective way of harnessing energy and can give up to 5, 00,000 volts on efficient allocation but, however, the implementation is yet to be done.

The Piezo-crystals that can be used in the IC engines:

i. Tourmaline
ii. Gallium phosphate
iii. PZT (Lead Zirconate Titanate)
iv. PVDF (Polyvinylidene Fluoride)

V. Harnessing Tidal Energy, Unconventionally

For meeting the energy requirement in future we have hypothesized the use of piezoelectric effect in the harnessing tidal energy which is copious in the world. India has a coastline of 7517 km that potentially renders it an ample repository of energy source.

The proposed plan is to forge a wall that is equipped with the array of piezoelectric crystal's tiles – in the same pattern as used in the floor of the Tokyo Station - at the sea shore, directly facing the mighty tides. The thickness of the wall can be augmented by the incorporation of several layers of the array of the tiles. This would provide the wall with the ample amount of rigidity to confront the mighty waves of Tsunamis. The installed layers would impart the wall with the Shock Absorbing property as there would be the compression of the layers few cm (1or 2cm, roughly) inside. Since whole of the connection is in direct contact with water, all the wirings and connections should be fabricated in a way to prevent the percolation of water inside the fabrication.

We are very much familiar with the might of the tidal waves and so with the frequency of the tides. So, in this scenario, even the subtle implementation of piezoelectric effect will be well suited.

And imagine the amount of energy that will be produced when a massive high tide make an impact on the wall. If we are not mistaken then, it will count millions of volts in one strike then, you can imagine how huge the amount of energy will be generated in a mere month? ……

VI. Conclusion

On the grounds of the Technology discussed above, it can be, emphatically, asserted that there are innumerable facets, in the real world, to be dovetailed with the piezoelectric effect & the substances for the developing a storage sink for the energy that is being lost on the daily basis. With the further research & development in the field of developing a highly efficient piezoelectric material the present efficiency of around 25% can be increased considerably. The technology is easy to comprehend and to visualize in different spheres of energy losses; a good amount is required for every implementation.

VII. Acknowledgement

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