Application of Power Generation Characteristics of Micro-generators and Piezoelectric Ceramics

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Abstract: With the economic development and the acceleration of social information, people in the improvement of living standards at the same time, due to extravagance and waste and other bad habits, making energy consumption growing, the negative impact on the natural environment is becoming increasingly serious. If we attach the piezoelectric ceramic to the surface of the wind turbine, the car, the windy area, when the wind works on the surface of the piezoelectric ceramic, we will generate electricity, and we will use these small amounts of electricity to collect and use The Therefore, we can use wind energy to act on piezoelectric ceramics, thus generating electricity, to achieve further use of wind energy. We will put the piezoelectric ceramic energy generated, to a certain amount and then can be used, both to a certain extent, reduce the consumption of resources, but also to facilitate our lives.

1. Introduction

Oil and other resources in our lives play an indispensable role, but they are limited, low-carbon life is increasingly becoming a trend. We have noticed that every moment of the wind movement between the land and the sea, sometimes refreshing, and sometimes it is disgusting. At present, people use wind to make magnetic changes in power generation has long been recognized by most people. For the current social environment, all kinds of resources are different degree of overdraft, and soil, air, water and other natural environment has also been different degrees of pollution, energy-saving emission reduction has become the world's high priority issues. At present, around the world around the focus of energy-saving emission reduction research topics, such as wind energy, heat, light energy and so on a series of energy. Piezoelectric ceramics is a material that converts mechanical energy with electrical energy.

2. Work theory

2.1 Miniature Generator

The miniature generator consists of a three-phase synchronous generator, several conversion gears, fixed plate, rectifier circuit and filter circuit. It is widely used in hand charger, emergency power box, LED flashlight, emergency charger, radio, hand emergency Products, cameras, remote control, car lights, camping lights and portable lights.

Micro-generators are usually composed of parts such as stator, rotor, end cap and bearing. The stator consists of a stator core, a wire wrap, a base, and other structural parts that secure these parts. The rotor consists of a cylindrical magnet. By the bearing and the end of the generator stator and rotor connection assembled, so that the rotor can rotate in the stator to do the movement of magnetic lines, resulting in induction potential, through the terminal leads, connected to the circuit, it produced a current. Micro-generators are mainly suitable for charging small batteries, so the need for the motor when the AC into DC, the need for its rectifier and filter.

2.2 Piezoelectricity

The nature of the potential difference between the both ends of the dielectric due to the polarization of the dielectric under pressure. 1880 French P. Curie and J. Curie brothers found that quartz crystal pressure, some of its surface will produce electricity, the amount of charge is proportional to the pressure; called this phenomenon for the piezoelectric effect; with piezoelectric The effect of the object is called the piezoelectric body. Curie brothers also confirmed that the piezoelectric body has a reverse piezoelectric effect, that is, under the action of the external electric field piezoelectric body will produce deformation. The symmetry of the piezoelectric crystal is low, and the relative displacement of the positive and negative ions in the cell is deformed by the positive and negative charge centers when the deformation occurs by the external force, resulting in the macroscopic polarization of the crystal. The crystal surface charge density is equal to the polarization in the surface of the normal projection, so the crystal pressure deformation occurs when the surface charge.

In short, piezoelectricity refers to the polarization of certain asymmetric centers of crystalline material in proportion to the applied mechanical stress, resulting in the ability of the opposite ends of the crystal to produce a sign opposite charge. When an electric field is applied to such crystals, the crystal will produce a strain proportional to the intensity of the electric field. Piezoelectric ceramics have a sensitive feature that can convert weak mechanical effects into electricity. Piezoelectric ceramic generator utilizes piezoelectric power generation. The following two graphs represent two different piezoelectric effects of piezoelectric ceramics.

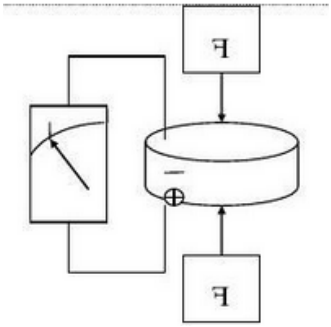

Figure 1. Positive piezoelectric effect

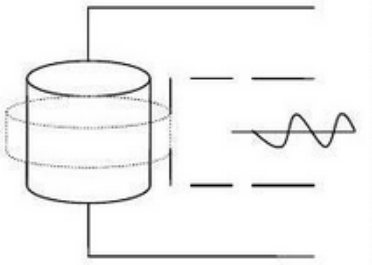

Figure 2. Inverse piezoelectric effect

3. Pirzoelectric ceramic performance

3.1 Mechanical Quality Factors

The mechanical quality factor is a dimensionless physical quantity, which is represented by Qm. Qm produces the essence of the mechanical quality factor Qm value of the piezoelectric body in the resonance due to overcome the friction and consumption of energy. Specifically defined as:

Qm = 2 π (energy of the mechanical energy stored in the resonator at the resonator / energy of the resonant weekly oscillator).

It can be seen that the mechanical quality factor Qm value reflects the mechanical loss of piezoelectric materials, the smaller the mechanical loss, the greater the Qm value.

In the actual calculation of the material Qm value, the equivalent circuit for the piezoelectric oscillator, using the following approximate formula:

Qm = 1/4*(C0 + C1) R1*F

Where C0 is the static capacitance of the piezoelectric oscillator, R1 is the equivalent resistance when the resonator is resonant, C1 is the dynamic capacitance of the vibrator, and Δf is the difference between the resonant frequency f r of the vibrator and the antiresonant frequency f a.

In the actual operation, we generally use the transmission line method, measured Δf, R1, etc., and then calculate the Qm value. Theoretically, it is possible to adjust the Qm value of the piezoelectric ceramic material and improve the temperature stability of the piezoelectric ceramic material, so that the piezoelectric ceramic material can be obtained more widely. Effective method of application.

3.2 Piezoelectric Constants and Piezoelectric Equations

In general, the piezoelectric constant is a parameter that represents the relationship between the stress received by the piezoelectric material and the charge generated. Specifically, if we set the piezoelectric ceramic stress to T, the strain is set to S, the electric field strength is set to E, and the electric displacement is denoted by D, then the following equation satisfying these quantities is called the piezoelectric equation The In the case of

Positive piezoelectric effect: D = Td d is the piezoelectric constant (C / N)

D1 = d11TI + d12T2 + d13T3 + d14T4 + d15T5 + d16T6

D2 = d21T1 + d22T2 + d23T3 + d24T4 + d25T5 + d26T6

D3 = d31T1 + d32T2 + d33T3 + d34T4 + d35T5 + d36T6

d The first subscript represents the direction of electricity, and the second subscript represents the direction of the machine (force or deformation). The actual use of piezoelectric ceramics due to the symmetry, the standard is simplified, the piezoelectric constant matrix

0 0 0 0 d15 0 (0 0 0 d24 0 0) d31 d32 d33 0 0 0

3.3 Electromechanical Coupling Coefficient

In the process of vibration, the mechanical energy is converted into electrical energy, or the electrical energy is converted into mechanical energy. This means that the degree of energy conversion is represented by the electromechanical coupling coefficient, that is, k & = Ec/Ee. In addition, K * K= electrical energy converted by piezoelectric effect / input mechanical energy.

4. Design of piezoeletric ceramic geramic generator

The piezoelectric ceramic material covers the surface of the wind turbine blades, divided into two power generation parts inside and outside, we only external ---- piezoelectric ceramic part of the power generation to do research. The energy converter comprises a piezoelectric transducer, a limit column, a spring plate and a pressure plate, wherein the energy converter comprises an energy converter, a power converter, a power converter, a power converter, a power converter, Both sides of the column to set the bottom of the space to install the piezoelectric oscillator, the piezoelectric oscillator in the top of the placement of the elastic plate and pressure plate. Used for energy storage for people to use. Figure 3 shows the flow diagram of a piezoelectric ceramic generator design.

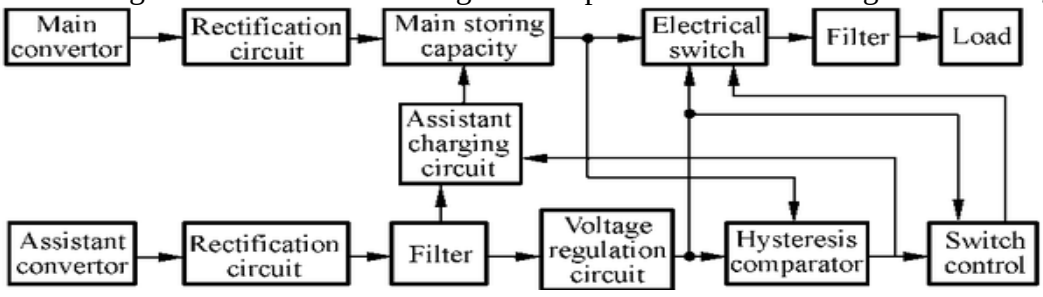

Figure 3. Piezoelectric ceramic generator design

5. Ferore the promotion of technology to consider

Piezoelectric ceramics is a bidirectional effect element, that is, it is added to the electricity, it produces mechanical deformation, if forced to produce mechanical deformation, and it produces electricity. And its two-way conversion efficiency is very high, of course, the conversion efficiency is still less than magnetic / mechanical conversion. But it has the advantage of magnetic / mechanical conversion can not be competent, it can be very small mechanical vibration displacement, converted into electrical energy. And can be a smaller size, cheap, simple structure, used in many special occasions, and the use of magnetic / mechanical conversion is difficult to apply in such occasions, even if the application is not economical. The energy produced by the piezoelectric ceramic sheet is mainly related to the following parameters: the piezoelectric constant of the piezoelectric sheet, that is, d 33, the dielectric constant, the magnitude of the applied stress F, and the region where the stress is applied. Therefore, in the ceramic piezoelectric technology to promote, we should consider in detail the following questions:

First, to consider the selection problem. Existing PZT piezoelectric ceramics, ZnO piezoelectric ceramics and other materials, taking into account the cost, industrial production, practical and beautiful problems, we have to use the kind of piezoelectric ceramic material the most practical. In the case of

Second, select the material after the production of piezoelectric generator performance test, clear its internal structural parameters and power generation capacity between the established data relationship.

Three, how to generate the electricity stored, the release of the problem. You can use the capacitor to store electricity, batteries can also, but to low pressure, low wear and tear.

Fourth, different production of piezoelectric ceramic performance will be different, according to the requirements of the relevant adjustment factors (such as calcination temperature, cooling method).

In view of the above facts, we should do the following in advance to improve the efficiency of piezoelectric power

Generation preparation:

(1) The choice of larger electromechanical coupling coefficient of piezoelectric materials;

(2) To reduce the piezoelectric material dielectric constant; Stress in the area of action. Or, the use of physical and chemical methods in the surface of the material coated with a layer of ceramics, the efficient use of energy is of great significance. Expanded the application of ceramics, but also contributed to the development of coating professional and technical. This new type of generator will be people in the work and life of a large number of ineffective mechanical energy can be collected and converted into electricity for human beings to provide inexhaustible renewable energy. Really contribute to low-carbon life a force.

6. Conclusion

In this paper, a series of theoretical and factual basis are obtained by studying the power generation principle of piezoelectric ceramic power generation and analyzing the power generation efficiency. After theoretical calculations, the power generation efficiency appears to be very low, mainly because the selected equivalent model is very different from the actual situation, and many other factors are omitted. In particular, the existence of vibration frequency has a great impact on the efficiency of power generation, in order to simplify the needs of the model without consideration. Piezoelectric ceramic power output is alternating current, and small, but can be accumulated, the resulting current through the rectifier into a DC stored in the capacitor, to be reached after a certain voltage to the micro-battery charge. After the cumulative power is still considerable, can provide power for wireless devices, especially when the phone is no electricity to solve the urgent needs. The emergence of piezoelectric ceramic power generation to meet the needs of low-carbon, it is safe and pollution-free, environmentally friendly, is a clean energy use. Has a broad development prospects.

The technology also solves the special situation is not easy to replace the battery situation, but also for the case of no power supply to bring the convenience of self-sufficiency. Believe that the technology can provide a reference for the development of new energy sources. In the future will have a wider range of applications.

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