

Experiment No: Date:

Piezoelectric Transducers

Enroll No: Semester:

Name :



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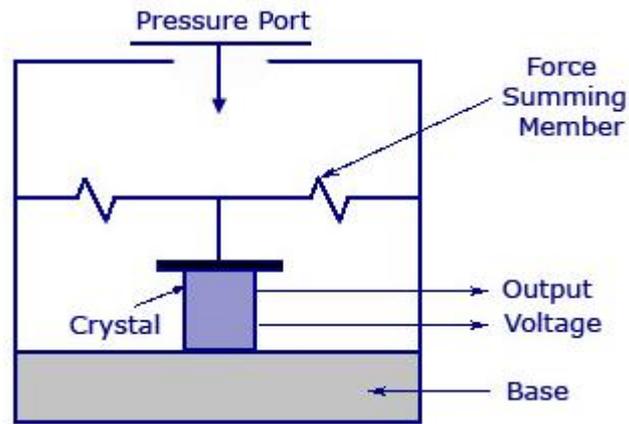


Fig. 1 Construction Piezo Electric Transducer.

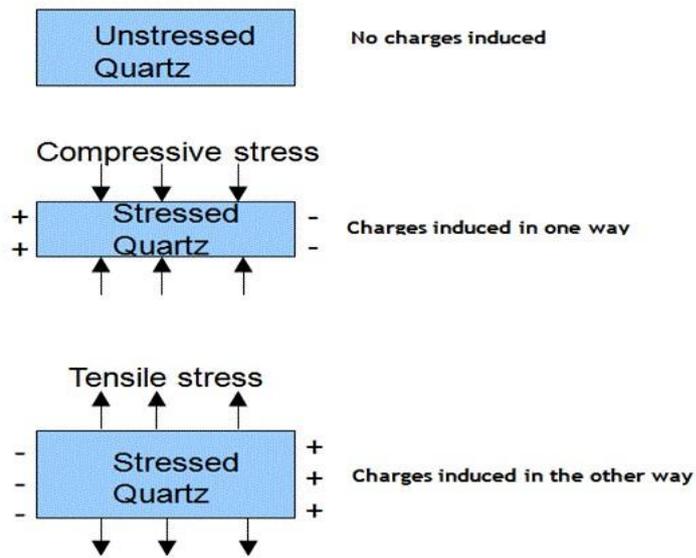


Fig. 2 Working of Piezo Electric Transducer

Aim: To study the operation and Characteristics of Strain Guage for measurement of Weight.

Theory : A transducer can be anything which converts one form of energy to another. Piezoelectric material is one kind of transducers. We squeeze this material or we apply force or pressure on this material it converts it into electric voltage and this voltage is function of the force or pressure applied to it. The material which behaves in such a way is also known as piezoelectric sensor.

The electric voltage produced by piezoelectric transducer can be easily measured by voltage measuring instruments, which can be used to measure stresses or forces. The physical quantity like mechanical stress or force cannot be measured directly. Therefore, piezoelectric transducer can be used.

Piezoelectric Actuator

Piezoelectric actuator behaves in reverse manner of piezoelectric sensor. It is the one in which the electric effect will cause the material to deform i.e. stretch or bend.

That means in piezoelectric sensor, when force is applied to stretch or bend it, an electric potential is generated and in opposite when on a piezoelectric actuator, an electric potential is applied it is deformed i.e. stretched or bend.

Piezoelectric transducer consists of quartz crystal which is made from silicon and oxygen arranged in crystalline structure (SiO₂). Generally, unit cell (basic repeating unit) of all crystal is symmetrical but in piezoelectric quartz crystal it is not. Piezoelectric crystals are electrically neutral. The atoms inside them may not be symmetrically arranged but their electrical charges are balanced means positive charges cancel out negative charge. The quartz crystal has unique property of generating electrical polarity when mechanical stress applied on it along certain plane. Basically, There are two types of stress. One is compressive stress and other is tensile stress.

When there is unstressed quartz no charges induce on it. In case of compressive stress, positive charges are induced in one side and negative charges are induced in opposite side. The crystal size gets thinner and longer due to compressive stress. In case of tensile stress, charges are induced in reverse as compare to compressive stress and quartz crystal gets shorter and fatter.

Piezoelectric transducer is based on principle of piezoelectric effect. The word piezoelectric is derived from Greek word piezen, which means to squeeze or press. Piezoelectric effect states that when mechanical stress or forces are applied on quartz crystal, produce electrical charges on quartz crystal surface. The piezoelectric effect is discovered by Pierre and Jacques curie. The rate of charge produced will be proportional to rate of change of mechanical stress applied on it. Higher will be stress higher will be voltage .

One of the unique characteristics of piezoelectric effect is that it is reversible means when voltage is applied to them ,they tends to change dimension along



certain plane i.e quartz crystal structure is placed into electric field, it will deform quartz crystal by amount proportional to strength of electric field. If same structure is placed into an electric field with direction of field reversed, the deformation will be opposite.

Quartz crystal becomes shorter due to electric field applied in reversed direction. It is self-generating transducer. It does not require electric voltage source for operation. The electric voltage produced by piezoelectric transducer is linearly varies to applied stress or force. Piezoelectric transducer has high sensitivity. So, it acts as sensor and used in accelerometer due to its excellent frequency of response.

The piezoelectric effect is used in many application that involve production and detection of sound, electronic frequency generation. It acts as ignition source for cigarette lighter and used in sonar, microphone, force, pressure and displacement measurement

Application

1. In microphones, the sound pressure is converted into electric signal and this signal is ultimately amplified to produce louder sound.
2. Automobile seat belts lock in response to a rapid deceleration is also done by piezoelectric material.
3. It is also used in medical diagnostics.
4. It is used in electric lighter used in kitchens. Pressure made on piezoelectric sensor creates an electric signal which ultimately causes flash to fire up.
5. They are used for studying high speed shock waves and blast waves.
 - i. Used in fertility treatment
6. Used in Inkjet printers
7. Used in Inkjet printers.
8. automatically It is also used in restaurants or airports where when a person steps near the door and the door opens.
9. In this the concept used is when person is near the door a pressure is exerted persons weight on the sensors due to which the electric effect is produced and the door opens automatically.

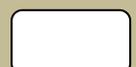
Advantages of Piezoelectric Transducer

1. No need of external force.
2. Easy to handle and use as it has small dimensions.
3. High frequency response it means the parameters change very rapidly.

Disadvantages of Piezoelectric Transducer

1. It is not suitable for measurement in static condition.
2. It is affected by temperatures .
3. Output is low so some external circuit is attached to it.

It is very difficult to give desired shape to this material and also desired strength.



Conclusion:

Signature of Staff with Date: _____

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