

Health and Electricity

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ABSTRACT

A new method for generation of electricity with the help of mechanical energy which is obtained by exercisedone on treadmill machine is presented in this paper. This concept of treadmill is based on Piezoelectrictransducer. The ability to transform mechanical strain energy to electrical energy is provided by the crystalline structure of the piezoelectric material.To store the generated electricity the rechargeable battery is used. The mechanical strain generated by carrying out workout is converted into electrical energy and then stored in battery for further use. The concept of this Treadmill is presented in this paper.

Keywords: *Piezoelectricity, Piezoelectric Effect, Transducers, Battery Storage, Converters.*

1. INTRODUCTION

A treadmill is a machine used for walking, climbing as well as running. To diagnose lung and heart disease some workout treadmills are designedthese treadmills are designed by Dr. Robert Bruce and Wayne Quinton. This invention of the treadmill is done at university of Washington in the year 1952. Treadmills are mostly motor driven. Majority of the treadmills contains the belt which moves with the help of the motor. The running belt is stretched over the length of the treadmill.

The person is moving on a running belt, the adjustable belt speed is adopted by the person running on the treadmill. The running belt has shock absorbers so that the treadmill won't get damaged by running. The belt can be made inclined so that the person running on treadmill can perform the exercises which can be done on hilly areas. For downhill exercises the rotation of the belt could be reversed. The table length of the treadmill is 300cm also the width of the treadmill is 100cm. Larger and more stable treadmills are necessary for athletes. Due to the risk of falling a stop unit is required to stop the treadmill.



Fig. 1 : Treadmill

Applications of the treadmill:

- In some of the offices there are treadmills which are used by employees for walking purpose.
- Treadmills are generally used for Workout and Pain Relief
- Treadmill is one of the most popular home workout machines.
- Treadmill provides the straightforward, aerobic and efficient workout method.
- Treadmill can be used as a strength training machine.
- Treadmill is mostly used for jogging.



Fig. 2: NASA astronaut T.J. Creamer, Expedition 22 flight engineer, equipped with a bungee harness, workouts on the Combined Operational Load Bearing External Resistance Treadmill (COLBERT) in the Harmony node of the International Space Station.

Advantages of Treadmill:-

- It allows the person to set up an workout irrespective to the condition of the weather.
- For significant use of the calories the inclination of the treadmill is used.
- Consistent uphill workout is provided by inclined treadmills which is not possible while natural workouts.
- Inbuilt programs of some treadmills can simulate various locations
- User can watch television while exercising on treadmill as well as user can listen to other entertainment devices.

2. PIEZOELECTRICITY

In response to applied mechanical stress piezoelectricity is electricity that accumulates in certain materials such as ceramics, quartz, some DNA constraints, some proteins, bones etc. French physicists Jacques and Pierre curie. Electricity resulting from pressure and latent heat is called as piezoelectricity.

Direct piezoelectric effect is the piezoelectric effect which produces electricity by applying mechanical stress to piezoelectric materials. The inverse piezoelectric effect is the effect which produces the mechanical strain by applying the electric charge to piezoelectric materials. For example when the crystalline structure of the lead zirconate-titanate is deformed by 0.1 percent then the measurable electricity is produced as well as when the electric charge is applied its crystalline structure deforms by 0.1. Ultrasonic waves can be generated by inverse piezoelectric effect.

Some of the applications of piezoelectricity are as follows:-

- Detection and production of the sound.
- High voltages can also be produced.
- Electronic frequency can be produced.
- It is used for driving ultrasonic nozzle.
- It is used for ultrafine focusing of optical assemblies.

3. HIGH VOLTAGE AND ENERGY SOURCES

Potential difference of thousands of volts can be produced with the help of some materials such as quartz which shows direct piezoelectric effect. An attempt to provide electricity to battlefield equipment is being researched by DARPA (Defense Advanced Research Projects Agency). There was piezoelectric generators embedded in soldiers shoes. There are other energy harvesting ideas like harvesting energy from human movements at train stations. With the help of piezoelectric transducers energy can also be harvested from dance floor by using vibrations produced. These energy can be stored in batteries and can be used further to provide power to microprocessors and some radio devices.

A type of AC voltage multiplier is a piezoelectric transformer. To drive fluorescent lamps these devices can be used. Some of the most high voltage source are piezo transformers. We should use rectifiers to convert alternating current to direct current for storage purpose. We can use switchable full bridge rectifiers as a voltage multiplying rectifier. To produce steady current we can use electronic filters like chock, capacitors, resistors and voltage regulators. We can use inverters to supply alternating current for AC devices. An inverter is a device which has the opposite function that converts direct current to alternating current. To charge batteries in less time we have to increase current.

Any spatially separated charge will result in an electric field, and therefore an electric potential. Shown here is a standard dielectric in a capacitor. In a piezoelectric device, mechanical stress, instead of an applied voltage, causes the charge separation in the individual atoms of the substance. Therefore piezoelectric charge should also be stored in capacitors.

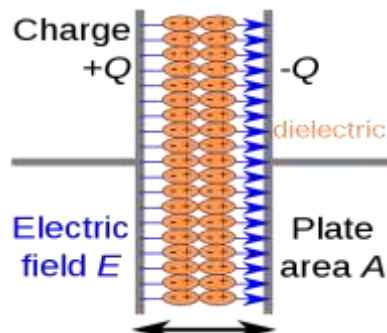


Fig. 3: Plate Separation

Piezoelectric substances are used to obtain energy from exerted forces or vibrations. The deformation of the substance produces an internal dipole moment, which in turn, produces an electrical charge across its surfaces. This process is reversible when an electric current is running through the substance, its shape also changes. The polarity of charge results in an alternating current (AC), which is then converted into direct current (DC). The converted current is useful for charging a capacitor or a battery, which can store the energy for further use.

For generating energy the belt of the treadmill should be equipped with the piezoelectric crystals in which piezoelectric substances produce an electric current when compressed or bent.

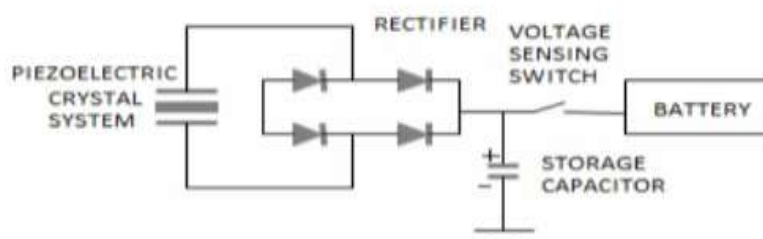


Fig. 4: Circuit Diagram

Data calculations:-

As we know the equation of power is as follows:-

$P=IV$; where P is power; I is current and V is voltage

So we have

Power = 3.3mW if voltage is 3v and current is 1.1 mA

Power = 5.421Mw if voltage is 4.17v and current is 1.3mA

Power = 8.823mW if voltage is 5.19v and current is 1.7 mA

Power = 13.02mW if voltage is 6.2v and current is 2.1 mA

If there is a person having waight of 70kg then we have the power of 13.02mW. So if any person having 70 kg weight is running on a treadmill (having piezoelectric sensors attached) for one minute and if he moved 40 steps per minute then we get the power which is given as follows

$P=13.02*40 =520mW$ /minute.

So if we add large numbers of piezoelectric transducers in series on the treadmill then the output power will be increased and after that we can connect a bunch of them in parallel to increase current so that we can charge rechargeable batteries. As input current increases the time required for charging the battery decreases. If the person runs on a treadmill for 28 minutes then we could turn on 14 Watt bulb which can illuminate entire room.

Future applications of this technology should be as follows

- Power generated by multiple treadmills can be used as power source for entire gym.
- It can be used in space stations at its gym for generating electricity and keeping the astronauts healthy.
- It can be used in jogging track in public parks which could power up an entire park.
- This treadmill can be used for home use and its power could be harvested.
- This technology can be used at toll plaza where large amount of energy can be generated as vehicles passes frequently.

4. CONCLUSION

Electricity can be generated using piezoelectric transducers. This concept of this treadmill which has piezoelectric transducers placed within the treadmill can be used in different real life applications to provide more efficiency. It can be also used to save energy.

5. REFERENCES

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