Conventional Way to Generate Electricity

Pravin Pandhare[1], Shubham Jangale[2], Lakhan Bhanupriya[3]

[1]*B. E Student, Mechanical Department, Nagpur Institute of Technology, Nagpur, Maharashtra, India*
[2] *B. E Student, Mechanical Department, Nagpur Institute of Technology, Nagpur, Maharashtra, India*
[3] *B. E Student, Mechanical Department, Nagpur Institute of Technology, Nagpur, Maharashtra, India*

ABSTRACT

Nowadays energy and power are the one of the basic needs in this modern world. Energy demand is increasing day by day due to modern equipment's for better standard of living. On the other hand, the many energy resources are getting exhausted and wasted. Proposal for utilization of waste energy of foot power with human locomotion is very relevant in populated countries like India where roads, railway stations, bus stands, temples, etc. are overcrowded and millions of people move around. This whole wasted energy made possible for utilization by the invention. In this project we are generating electrical power as non-conventional method by simply walking on the footsteps. Non-conventional energy using foot step needs no fuel input power to generate the electrical power. The rack and pinion assembly and chain drive mechanism are used for generating power. The generated power is stored by means of battery and this is used for activating LED lights on footsteps, advertisement boards etc.

Keyword: *Footsteps, Non-conventional energy, Rack & Pinion.*

---

1. INTRODUCTION

Design for the utilization of waste energy of foot power with human locomotion is very much relevant and important for highly populated countries like India and China where mobility of its masses will turn into boon in generating electricity from its footsteps. In India, places like roads, railway stations, bus stands, are all over crowded and millions of people move round the clock. As a result, large amount of power can be obtained with the use of this promising technology. This process involves number of simple setups that are installed under the walking platform. When people walk on this platform their body weight compresses the setup which rotates a dynamo or Sanyo coil and current produced. The power production is over crowded with moving population; energy is produced at larger levels. Greater movement of people will generate more energy.

The commercial success of the efforts of many countries has attracted the attention of many firms towards this design of staircase electricity generation. There has been a phenomenal rise in the number of patents granted by the US, Russia, China & other countries patent office every year. Another measure of the activity is the rate of article publication in the application area of "Design of Staircase electricity generation" there has been a large increase in publication rate in Russia, China & India. Electricity can be generated when people walk on the Floor. if we designed a power generating floor that can produce 100W on just 12 steps, then for 120 steps we can produce 1000 Watt. If we install such type of 100 floors with this system then it can produce 1 Megawatt.

2 LITERATURE REVIEW

Munaswamy B et al, Literature review carried out to check research work carried out by another researcher in this era. The authors regulated 5V power, 500mA power supply. Bridge type full wave rectifier is used to rectify the AC output of secondary of 230/12V step down transformer. The rack and pinion used to convert linear motion into rotational motion. Since the power generation using foot step get its energy requirements from Non-renewable source of energy. There is no need of power from external sources (mains) and there is less pollution in this source of energy. **[1]**

V. Jose et al, The authors used 80 volts and 40 mA from one coil have been generated from a prototype model as first invention. The second invention provides 95 volts and 50 mA from one coil and this generated power can be used to light LED array and to run DC fan after rectifying the AC or can charge batteries. For high efficiency in the axel of the second gear, they fitted a strong magnet vertically, so that when the gear will rotate due to human body weight the magnet also rotates. The magnet is placed in a loop type copper coil. When the magnet starts rotating according to the Faraday's law of electromagnetic induction, there will be induced EMF in the coil and electricity developed. **[2]**

Shiraz Afzal et al, In this project a gear system is attached with flywheel which causes to rotate the dynamo as the tile on the deck is pressed The created power saved in the batteries in addition we will be able to monitor and control the amount of electricity generated. When an individual pass it push the tile on the ground surface which turn the shaft beneath the tile, turn is limited by clutch bearing which is underpinned by holders. The movement of the prevailing shaft turn the gearbox shaft which builds it 15 times (1:15) then its movement is smoothen by the help of fly wheel which temporary store the movement, which is convey to the DC generator (it generates 12V 40 amp at 1000 rpm). **[3]**

Motey Yogesh et al, In this research paper author manufactured a model made from stainless steel, recycled car tires and recycled aluminum, also includes a lamp embedded in the pavement that lights up every time a step is converted into energy (using only 5 percent of the generated energy). The average square of pavement produces about 2.1 watts of electricity. And according to author, any one square of pavement in a high-foot traffic area can see 50,000 steps a day. Based on this data, only five units of pavement can be enough to keep the lights on at a bus stop all night. **[4]**

Tom Jose V et al, A piezoelectric tile is capable of generating more voltage when longer the time taken. The longer the time taken means more footstep/ any external force are applied on the tile. The linear relation is found between the voltage generated and the time taken. This piezoelectric are specifically suitable for the implementation in the crowed area such as pavement street, rain ticket counter, stair and dance floor. The piezoelectric tile is also suited to power up the street light, staircase light and also low power appliances. **[5]**

Magdum P. R et al, In this research work, the crank shaft and gear arrangement with fly wheel was used. So in order to implement this foot step power generation system we adjust the wooden plates above and below the sensors and moveable springs. When we walk on the mat then automatically force is applied on top moveable springs. In this research paper, the author studied three methods of foot step power generation namely piezoelectric method, rack and pinion method and fuel piston method. It is found that rack and pinion mechanism is more efficient with moderate cost of operation and maintenance. The author made attempts to show how energy can be tapped and used at a commonly used floor step and advertisement board. The usage of steps in every building is increasing day by day, since even every small building has some floors. A large amount of energy is wasted when we are stepping on the floors by the dissipation of heat and friction, every time a man steps up using stairs. The generated power can be stored by batteries, and it will be used for lighting the building**. [6]**

3. MOTIVATION

Human required energy primarily in the form of food. They derived this by eating plants or animals, which they hunted. With the passage of time, man started to cultivate land for agriculture. They added a new dimension to the use of energy by domesticating and training animals to work for them. With further demand for energy, man began to use the wind for sailing ships and for driving windmills, and the force of falling water to turn water for sailing ships and for driving windmills, and the force of falling water to turn water wheels. Till this time, it would not be wrong to say that the sun was supplying all the energy needs of man either directly or indirectly and that man was using only renewable sources of energy. Some developing countries and newly-industrialized countries have several hours of daily power-cuts in almost all cities and villages because of huge demand of electricity. People in these countries used a power-inverter (rechargeable batteries) or a diesel/petrol-run electric generator during the power-cut. The use of standby generators is common in industrial and IT hubs which ultimately leads to increases the shortage of power. This motivates us to carry out work to taped wasted non-conventional energy to develop electricity.

4. COMPONENTS OF PROTOTYPE

The footstep arrangement designed to generate the electric power. In this arrangement the mechanical energy is converted into electrical energy. Footstep arrangement consists of following components:

- Springs
- Gearwheel arrangement
- Rack and Pinion Section
- Chain drive Mechanism
- Coupling section
- Dynamo
- LEDs

4.1 Coil Springs

Fig-1: Coil Spring

A coil spring is made of resilient steel rod. It extends as the wheel moves down and compresses as the wheel moves up, so the car body remains reasonably level. A coil spring is simply a spiral of resilient steel rod. It is stretched or compressed by the vertical movement of the wheels.

4.2 Spur Gear Wheel Arrangement

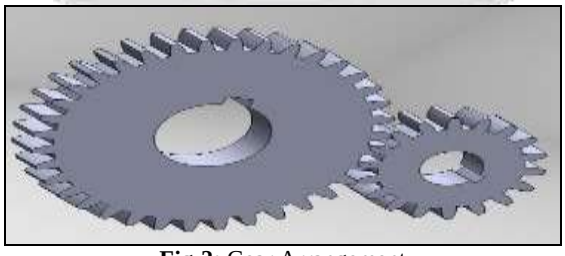

Fig-2: Gear Arrangement

Spur gears are constructed with straight teeth cut or inserted parallel to the gear's shaft on a circular (i.e., cylindrical) gear body. In mated pairs, these gears employ the parallel axes configuration to transmit motion and power.

4.3 Rack & Pinion

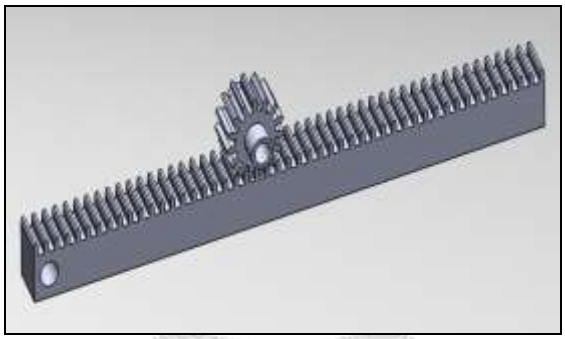

Fig-3: Rack and Pinion Section

Rack and pinion steering work by using a gear system to translate the steering wheel's circular motion into the linear motion needed to turn the wheels. The pinion gear connects to the steering shaft so that the gear will spin and move the rack when the steering wheel turns.

4.4 Shaft

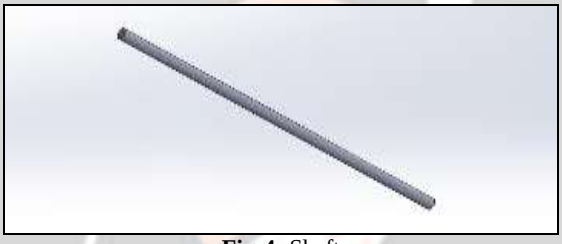

Fig-4: Shaft

A shaft is a rotating machine element, usually circular in cross section, which is used to transmit power from one part to another, or from a machine which produces power to a machine which absorbs power.

A shaft is a rotating machine element which is used to transmit power from one place to another. The various members such as pulleys, bearing, etc. are mounted on the shaft to transfer the power from one shaft to another. These members along with forces exerted upon them causes the shaft to bending. It is made up of mild steel. It is a straight rod, having a step. It is supported by the bearing. A shaft is a rotating machine element which is used to transmit power.

4.5 Bearing

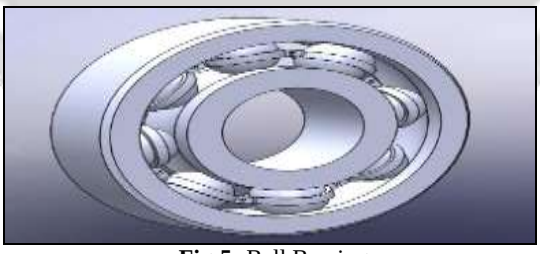

Fig-5: Ball Bearing

Ball bearing is to reduce rotational friction and support radial and axial loads. As one of the bearing races rotates it causes the balls to rotate as well. Because the balls are rolling they have a much lower coefficient of friction than if two flat surfaces were sliding against each other. A bearing is machine element which supports another moving machine element. The moving machine element is known as journal. Bearing permits a relative motion between the contact surfaces of the members, while carrying the load. A certain amount of power is wasted in overcoming frictional resistance. In order to reduce frictional resistance and wear and to carry away the heat generated, lubricant may be provided. The lubricant used is usually a mineral oil refined from petroleum.

4.6 Chain Drive

Fig-6: Chain Drive

Chain drive is a way of transmitting mechanical power from one place to another. It is often used to convey power to the wheels of a vehicle, particularly bicycles and motorcycles. Most often, the power is conveyed by a roller chain, known as the drive chain or transmission chain, passing over a sprocket gear, with the teeth of the gear meshing with the holes in the links of the chain. The gear is turned, and this pulls the chain putting mechanical force into the system. Another type of drive chain is the Morse chain, invented by the Morse Chain Company of Ithaca, New York, USA. This has inverted teeth.

4.7 Battery

Fig-7: Battery

Battery (electricity), an array of electrochemical cells for electricity storage, either individually linked or individually linked and housed in a single unit. An electrical battery is a combination of one or more electrochemical cells, used to convert stored chemical energy into electrical energy. Batteries may be used once and discarded, or recharged for years as in stand by power applications. Miniature cells are used to power devices such as hearing aids and wrist watches; larger batteries provide standby power for telephone exchanges or computer data centres. Lead-acid batteries are the most common in PV System because their initial cost is lower and because they are readily available nearly everywhere in the world. There are many different sizes and designs of lead-acid batteries, but the most important designation is that they are deep cycle batteries. Lead-acid batteries are available in both wet-cell (requires maintenance) and sealed no-maintenance versions. These batteries are used in inverter & UPS system and have the proven ability to perform under extreme conditions. The batteries have electrolyte volume, use PE Separators and are sealed in sturdy containers, which give them excellent protection against leakages and corrosions.

4.8 Inverter

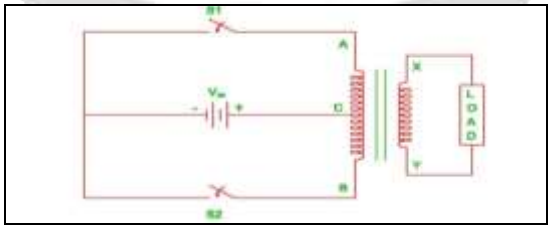

Fig-8: Inverter

Inverters convert low frequency main AC power to higher frequency for use in induction heating. To do this, AC power is first rectified to provide DC power. The inverter then changes the DC power to high frequency AC power. This new inverter can avoid extra clamping diodes or voltage balancing capacitors. In the first step the footstep is directly connected to the Rack & pinion arrangement. To the pinion shaft dynamo is provided and LEDs are coupled to it.

5. WORKING PROCESS

With the help of block diagram as show in figure 9, the working procedure is explained in step by step manner. In this project we are converting Mechanical energy into Electrical energy. We are trying to utilize the wasted energy in a useful way. By using Rack and Pinion arrangement we are converting to and fro motion of the steps into rotational motion of the dynamo.

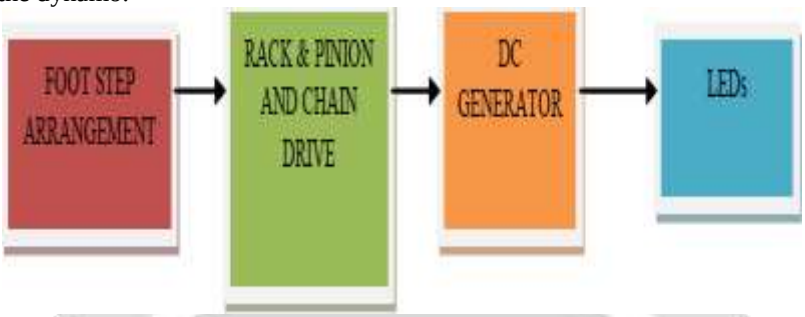

Fig-9: Working process of proposed prototype model

The following steps are involved in the process:

Step1: When force is applied on the plate by virtue on stamping on the plate the force spring gets compressed.
Step 2: Due to this the rack moves vertically down.
Step 3: The pinion meshed with the rack gear results in circular motion of the pinion gear.
Step 4: For one full compression the pinion Moves one semicircle, when the force applied on the plate released the pinion reverses and moves another semi-circle.
Step 5: The intermediate gear with a greater number of teeth will rotate as a result of motion of pinion.
Step 6: The generator attached to the intermediate will obtain the rotating motion, hence results in the sinusoidal waveform (for Single Generator).
Step 7: The voltage signal thus obtained will be displayed in LCD display

The main phenomenon on which the working of this project is that rack and pinion assemble converts the linear motion into rotary motion and vice versa also. The pinion is of finite diameter and gives circular motion when the rack of infinite diameter comes in contact with pinion and gives linear or translator motion for proper contact between both rack and pinion the should have equal module. The shafts of rack and pinion remain parallel during their motion. The impact load is put on surface on the step. One end of spring is attached to the other surface of step (plate) and another end is fixed to the stand. Firstly, the spring is compress down due to impact of load. During this process the energy is absorbed in the spring. When the weight is removed from the top of the plate, the spring comes back to its original position. By releasing the energy inside it and the plate moves upward and return its original position.
When the spring is compressed due to impact of weight on plate, the energy absorbed in the spring and the rack move downward direction vertically and the rack is in contact with pinion. So, pinion rotates in anti-clockwise direction. The pinion shaft is directly coupled with dynamo (generator). So, dynamo generates electricity. When the spring expends releasing the energy stored inside it, the rack moves in upward direction vertically and the rack is in contact with pinion. So, pinion rotates in clock wise direction. The pinion shaft is directly coupled with dynamo. So, dynamo generates electricity. If we want to store the electrical energy for future use, we connect the dynamo to the invertors which store the energy in the form of D.C. in the battery.

Table -1: Estimated Cost for the Prototype

SR.NO.	COMPONENT	DETAILS	COST in Rs
1.	Base plate and upper plate	Mild steel - 300×300 mm (300×2)	1000
2.	Fixed Cylindrical pipes	M.S. pipes,30mm dia.-100mm length (100×4)	400
3.	Moving pipes	MS pipes,20 mm dia.100mm length (100×4)	400
4.	Springs	Alloy Steel Wire (100×4)	400
5.	Stair frame	MS l angle frame	1000
6.	Rack and pinion	Cast iron, module 1.5	1100
7.	DC motor	12 volt,60 rpm	250
8.	Fabrication	Cutting, welding etc.	600
9.	Assembly	Mounting, fixing motor shaft with pinion. Adjusting rack and pinion etc. and final welding	500

6. ADVANTAGES

The proposed project is depending on non-conventional sources which will waste if not utilized. The small invention to tap untapped energy to generate electricity will lead to reduce power cut in the city. The following advantages of this proposed project will make favorable situation to work on it.

- No need of fuel input.
- Power generation is simply walking on the footstep.
- Battery is used to store the generated power.
- No pollution
- It is fully eco-friendly
- Easy construction
- Easy maintenance because of less moving parts.

CONCLUSION

1. Footstep power generation system produces electricity by utilizing energy which is wasted through walking. Mechanism like rack and pinion and piezo-electric material are integrated to produce desired output. Cost of electricity generation solely depends upon the initial cost, maintenance cost and life of system. Maximum advantage of this system can be taken if installed in highly dense area.

2. Since in this project of power generation there is not any fuel input requirement for the generation of electrical power. Thus, it can also be concluded that this mode of power generation system is eco-friendly, i.e., no pollution is caused during the generation of power using this type of model. Hence due to such advantages, this system can be embedded at any of the public places like railway platforms, busy foot-paths, malls etc.

3. Implementing this system, we can easily reduce our dependency on the conventional sources of energy, thus can be considered beneficial from that point of view.

4. It is able to extend this project by using same arrangement and construct in the footsteps/speed breaker so that increase the power production rate by fixing school and colleges, highways etc. Footstep power generation system produces electricity by utilizing energy which is wasted through walking. Mechanism like rack and pinion and piezo-electric material are integrated to produce desired output. Cost of electricity generation solely depends upon the initial cost, maintenance cost and life of system. Maximum advantage of this system can be taken if installed in highly dense area.

REFERENCE

[1] Munaswamy B., Prudhvi Ch., Srikanth V., Kirankumar B., Kumar Er. Pradeep, (2018) Mechanical Footstep Power Generation, India International Journal of Engineering Trends and Applications (IJETA) – Volume 5 Issue 2, Mar-Apr 2018

[2] V. Jose Ananth Vino, (2011) Bharath University, Power Generation Using Foot Step, International Journal of Engineering Trends and Technology (IJETT) – Volume1 Issue 2 – May 2011.

[3] Shiraz Afzal, Farrukhhafeez, (2014) Power Generation Footstep*. International Journal of Advancements in Research & Technology, Volume 3, Issue 4, April-2014.

[4] Motey Yogesh, Dekate Pooja, DekateMadhushri, AswaleJayashree, (2017) Footstep Power Generation System, International Journal of Innovations in Engineering and Science, Vol. 2, No.6.

[5] Tom Jose V, Binoy Boban, Sijo M T, (2013) "Electricity Generation from footsteps; A generative Energy Resources" International Journal of Scientific and research publication, pp 1-3, March 2013.

[6] Magdum P. R., Chikhale S. J., Rajole A. S., Jedhe S. S.,(2012) Generation of Electricity by Using Footsteps as a Source of Energy IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE) e-ISSN: 2278-1684,p-ISSN: 2320-334X PP. 50-56.