

Mechanical Footstep Power Generation

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ABSTRACT

In this project we are generating electrical energy by means of a non-conventional method just by walking on the footsteps. Non conventional system for energies are very much required at this time. Energy generation using footsteps requires no any fuel input to generate electricity. In this project we are generating electricity just with the help of rack and pinion arrangement along with alternator and chain drive mechanism. For its proper functioning such that it converts Force into electrical energy, the mechanism consists of rack & pinion, chain drives, alternator and battery. We have discussed its various alternate applications with extension also. The power generation is much worthy but it has little initial cost effective factors.

Keywords:- Foot Step, DC Generator, Rack and Pinion, Led's.

I. INTRODUCTION

As the availability of conventional energy declines, there is need to find alternate energy sources. All most all the state electricity departments in our country, they are unable to supply the power according to the demand. The power produced by these companies is not even sufficient for domestic utilities; in such critical situation it is very difficult to divert the energy for other public needs. There by an alternative source must be discovered, many people proposes for solar energy, but it is going to be a costliest affair, moreover availability of solar energy is poor particularly in rainy & winter seasons, as a result it is not dependable. Hence an alternative cheapest method must be determined for few applications; consequently this project work has been taken up, which is aimed to generate electricity from footsteps mechanism.

Out of the many alternative energy resources, this technology described in this project report is the ultimate source of all known forms of energy. It is clear, safe, and free, does not pollute the environment and thus will be an extremely viable alternative in the days to come. As there is a tremendous increase in the crowd, the load applied on the foot steps by the people, it generates nonstop energy, which can be stored and utilized to energize the street lights. Here the concept is to convert the mechanical energy in to electric energy.

Man has needed and used energy at an increasing rate for his sustenance and wellbeing ever since he came on the earth a few million years ago. Primitive man required energy primarily in the form of food. He derived this by eating plants or animals, which he hunted. With the passage of time, man started to cultivate land for agriculture. He added a new dimension to the use of energy by domesticating and training animals to work for him. 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.

This whole human energy being wasted if can be made possible for utilization it will be great invention and power producing platform will be very useful energy sources in crowded countries.

TYPES OF ENERGY RESOURCES

- conventional energy sources
- Alternative energy sources

CONVENTIONAL ENERGY SOURCES

Primary energy sources can be defined as sources which provide a net supply of energy coal, oil, uranium etc., are example of this type as shown

in fig.1.1. The energy required to obtain these fuel is much less than what they can produce by combustion or nuclear reaction.

The supply primary fuel is limited .It becomes very essential to use these fuel sparingly. Example: Coal, natural gas, oil and nuclear energy.

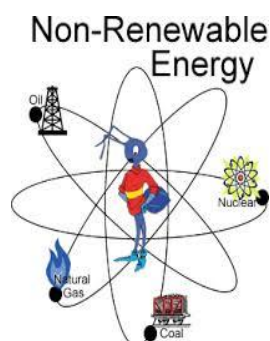


Fig.1.1.Non-Renewable Energy

ALTERNATIVE ENERGY SOURCES

It is any energy source that is an alternative to fossil fuel. These alternatives are intended to address concerns about such fossil fuels as shown in fig.1.2. The nature of what constitutes an alternative energy source has changed considerably over time, as have controversies regarding energy use. Today, because of the variety of energy choices and differing goals of their advocates, defining some energy types as "alternative" is highly controversial.

In a general sense, alternative energy as it is currently conceived, is that which is produced or recovered without the undesirable consequences inherent in fossil fuel use, particularly high carbon dioxide emissions, an important factor in global warming.

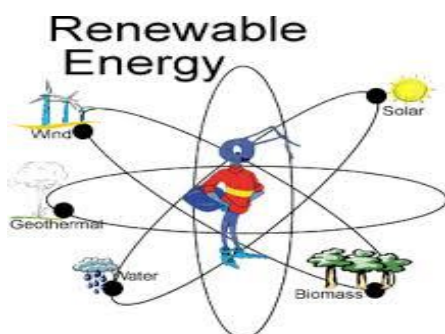


Fig.1.2 Renewable Energy

Question that every time comes before every country i.e. the need of non conventional energy sources or systems. Why we need these systems and the answers are the growing consumption of energy has resulted in the country becoming increasingly dependent on fossil fuels such as coal, oil & gas. Rising prices of oil and gases and their potential shortages have raised uncertainties about the security of energy supply in future, which has serious repercussions on the growth of the national economy. The main factor is increasing use of fossil fuels also causes serious environmental problems.

Hence there is primary need to use renewable energy sources like solar, wind, tidal, bio-mass and energy from waste material.

Man has needed and used energy at an increasing rate for his sustenance and wellbeing ever since he came on the earth a few million years ago. Primitive man required energy primarily in the form of food. He derived this by eating plants or animals, which he hunted. With the passage of time, man started to cultivate land for agriculture. He added a new dimension to the use of energy by domesticating and training animals to work for him. 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.

For an alternate method to generate electricity there are number of methods by which electricity can be produced, out if such methods footstep energy generation can be an effective method to generate electricity. Walking is the most common activity in human life. When a person walks, he loses energy to the road surface in the form of impact, vibration, sound etc, due to the transfer of his weight on to the road surface, through foot falls on the ground during every step. This energy can be tapped and converted in the usable form such as in electrical form. This device, if embedded in the footpath, can convert foot impact energy into electrical form.

Human-powered transport has been in existence since time immemorial in the form of

walking, running and swimming. However modern technology has led to machines to enhance the use of human-power in more efficient manner. In this context, pedal power is an excellent source of energy and has been in use since the nineteenth century making use of the most powerful muscles in the body. Ninety-five percent of the exertion put into pedal power is converted into energy. Pedal power can be applied to a wide range of jobs and is a simple, cheap, and convenient source of energy. However, human kinetic energy can be useful in a number of ways but it can also be used to generate electricity based on different approaches and many organizations are already implementing human powered technologies to generate electricity to power small electronic appliances.

Now let us come to its some working principle, this device if embedded in footsteps of railway platforms, city malls, city footpaths etc. can convert the weight impact of people into electrical energy. When a pedestrian will step on the top plate of this device, the plate will go down and this downward motion results in rotation of the shaft of the alternator which produces electrical energy. After removal of force the top plate returns to its original position due to springs.

II. EXISTING SYSTEM

Other people have developed piezo-electric (mechanical-to-electrical) surfaces in the past, but the Crowd Farm has the potential to redefine urban space by adding a sense of fluidity and encouraging people to activate spaces with their movement. The Crowd Farm floor is composed of standard parts that are easily replicated but it is expensive to produce at this stage. This technology would facilitate the future creation of new urban landscapes athletic fields with a spectator area, music halls, theatres, nightclubs and a large gathering space for rallies, demonstrations and celebrations, railway stations, bus stands, subways, airports etc. Like Capable Of Harnessing Human Locomotion For Electricity Generation.

III. PROPOSED SYSTEM

Proposal 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 the roads, railway stations, bus stands, temples, etc. are all over crowded and millions of people move around the clock. This whole human/bio-energy being wasted if can be made possible for utilization it will be great invention and crowd energy farms will be very useful energy sources in crowded countries. Walking across a "Crowd Farm," floor, then, will be a fun for idle people who can improve their health by exercising in such farms with earning. The electrical energy generated at such farms will be useful for nearby applications.

The creation of new source of perennial environmentally acceptable, low cost electrical energy as a replacement for energy from rapidly depleting resources of fossil fuels is the fundamental need for the survival of mankind. We have only about 25 years of oil reserves and 75 – 100 years of coal reserves. Resort to measure beginning of coal in thermal electric stations to serve the population would result in global elementic change in leading to worldwide drought and decertification. The buzzards of nuclear electric-stations are only too will. Now electric power beamed directly by micro-wave for orbiting satellite. Solar power stations (S.P.S) provide a cost-effective solution even though work on solar photo voltaic and solar thermo electric energy sources has been extensively pursued by many countries. Earth based solar stations suffer certain basic limitations.

IV. OBJECTIVES

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.

In first foot step we are using rack and pinion arrangement directly to rotate the dynamo. But in second step we are using gear mechanism to obtain better efficiency. Through Dynamo the rotational energy is converted into electrical energy. This electrical energy output will be shown by glowing the LEDs. The output power is expected to be 3 to 4V in prototype.

Depending upon the above Literature Survey of different papers we have decided to moved forward to take this project in practical means.

For this purpose we have aimed to construct a prototype for footstep mechanism by using rack and pinion motion. And also the storage system along with inverter circuit is arrangement in order to use the produced alternative energy for daily application by converting the DC to AC.

At last the prototype is assembled with a display unit who main aim is to show the exact amount of power available in battery.

V. LITERATURE REVIEW

[1] **“Power Generation in automobile suspension system** “by **C.Nithiyeshkumar,K.Gowtham,M.Manikandan,P.Bharathkanna, T.Manoj Kumar.**

In this research paper author studied three methods of foot step power generation namely piezoelectric method, rack and pinion method and fuel piston method comparatively and found that the rack and pinion mechanism is more efficient with moderate cost of operation and maintenance.

[2] **“Generation of Electrical Energy from Foot Step Using Rack and Pinion Mechanism”** by **Md.Azhar, Zitender Rajpurohit, Abdul Saif, Nalla Abhinay, P.Sai Chandu**

In this research paper authors used 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. A rack and pinion is a type of linear actuator including a pair of gears which convert rotational motion into linear motion. The “pinion” engages teeth on the rack. In this paper, 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. It is very useful to the places like all roads and as well as all kind of foot step which is used to generate the non-conventional energy like electricity.

[3] **“Electrical Power Generation Using Foot Step for Urban Area Energy Applications”** by **Joydev Ghosh, Amit Saha, Samir Basak, Supratim Sen.**

In this research paper 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 rotate. The magnet is placed in a loop type copper coil. When the magnet start rotating according to the Faraday’s law of electromagnetic induction, there will be induced emf in the coil.

[4] **“Power generation through step”** by **Vipin Kumar Yadav1, Vivek Kumar Yadav1, Rajat Kumar1, Ajay Yadav**

In these research paper authors used equipments with following specification: Motor Voltage:10 volt Type: D.C. Generator, RPM:1000 rpm, Gear 1-Mild Steel,No. of teeth:59(big gear),No. of teeth:36(small gear),Type: Spur Gear, No. of gear used:2 Spring 1-Load bearing capacity:60-90 kg, Mild Steel,Total displacement:5 inch, Bearing 1-Type: Ball bearing, Bearing no.N35,Shaft 1-Diameter: 15 mm- Material: Mild steel author concluded that with these method energy conversion is simple efficient and pollution free.

[5] **“Power Generation Footstep”** by **Shiraz Afzal, Farrukh hafeez**

This paper is all about generating electricity when people walk on the Floor if we are able to design a power generating floor that can produce 100W on just 12 steps, then for 120 steps we can produce 1000 Watt and if we install such type of 100 floors with this system then it can produce 1MegaWattAs a fact only 11% of renewable energy contributes to our primary energy. If this project is deployed, then not only we can overcome the energy crises problem but this also contributes to create a healthy global environmental change. 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 power that is created is saved in the batteries in addition we will be able to monitor and control the amount of electricity generated When an individual passes 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. Primary shaft is rotate approx. twice by a single tile push. 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).

[6] “Power Generation from Steps” by Ramesh Raja R, Sherin Mathew

This research paper attempts to show how energy can be tapped and used at a commonly used floor steps. 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. There is great possibility of tapping this energy and generating power by making every staircase as a power generation unit. The generated power can be stored by batteries, and it will be used for slighting the building.

[7] "Electricity Generation from Footsteps; A Regenerative Energy Resource" by Tom Jose V, Binoy Boban, Sijo M T

In these research paper author manufactured a model made from stainless steel, recycled car tires and recycled aluminium, 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 Pavegen pavement can be enough to keep the lights on at a bus stop all night.

VI. METHODOLOGY

The footstep arrangement is used to generate the electric power. Now a day's power demand is increased, so the footstep arrangement is used to generate the electrical power in order to compensate the electric power demand. In this arrangement the mechanical energy is converted into electrical energy.

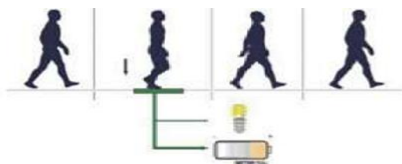


Fig 6 .schematic representation of foot step

The basic working principle of this project is based on the piezoelectric sensor. To implement this we adjust the wooden plates above and below the sensors and moveable springs. Non-conventional energy using foot step is converting mechanical energy into the electrical energy. When the pressure is applied, the rack and pinion will convert mechanical energy into electrical energy. This electrical energy will be storing in the 12v rechargeable battery connected to inverter. We are using conventional battery charging unit also for giving supply to the circuitry.

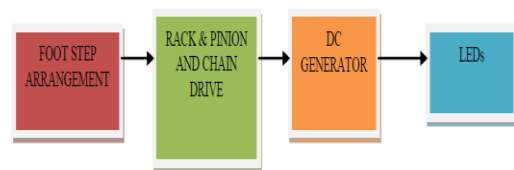


Fig: 6.1 Arrangement Of Foot Step

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.

In first foot step we are using rack and pinion arrangement directly to rotate the dynamo. But in second step we are using chain drive mechanism to obtain better efficiency.

Through Dynamo the rotational energy is converted into electrical energy. This electrical energy output will be shown by glowing the LEDs. The output power is expected to be 3 to 4V in prototype.

VII. COMPONENTS USED

The footstep arrangement is used to generate the electric power. Now a day's power demand is increased, so the footstep arrangement is used to generate the electrical power in order to compensate the electric power demand. In this arrangement the mechanical energy is converted into electrical energy.

This section is constructed by of rubber or other material which is placed within the surface areas.

This section is mainly placed in the crowded areas. This footstep arrangement is attached with spring section. Footstep section consists of

- Springs
- Foot – step
- Gearwheel arrangement
- Rack and Pinion section
- DC Generator
- LEDs
- Shaft
- Battery

The rack & pinion, spring arrangement is fixed at the inclined step. The spring issued to return the inclined step in same position by releasing the load. The pinion shaft is connected to the supporter by end bearing. The gearwheel arrangement is connected to the shaft which in turn is connected to the DC generator. The DC generator is connected to the battery and the LEDs

VIII. WORKING PRINCIPLE

The upper plate is mounted on two springs; the weight impact is converted into electrical power with proper control unit.

The spring and rack & pinion arrangement is fixed below the foot step which is mounted on base. Spring system is used for return mechanism of upper plate after release of load. The shaft along with pinion is supported by end bearings. One end is connected with small belt pulley system and on the other end a flywheel is mounted. The dc generator is rotated with the help of this belt & pulley arrangement. The terminal of DC generator is connected to lightning LEDs

WORKING PRINCIPLE: The complete diagram of the footstep power generation is given below. Only one step is inclined in certain small angle which is used to generate the power. The pushing power is converted into electrical energy by proper driving arrangement.

WORKING

The complete fabricated model picture of Foot Step is shown below. The upper plate is mounted on two springs; the weight impact is converted into electrical power with proper control unit. The spring and rack & pinion arrangement is fixed below the foot step which

is mounted on base. Spring system is used for return mechanism of upper plate after release of load. The shaft along with pinion is supported by end bearings. A gear is provided there also. A gear is coupled to the shaft. The gear wheel which is provided in shaft is coupled to the Dynamo. The dynamo capacity used here is 12V. From the dynamo the wires are taken. These wires are connected to a LEDs, to show the output power. The generator is used here is 12Volt permanent magnet DC generator. The terminal of DC generator is connected to lightning LEDs.

In the first step the footsteps is directly connected to the Rack & pinion arrangement. To the pinion shaft dynamo is provided and LEDs are coupled to it. Thus Mechanical energy is converted in to Electrical energy.

With the help of block diagram as show in the block diagram the working procedure is explained in step by step manner.

Step 1: 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 more 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 obtained voltage is passed through Ac neutralizer in order to reduce the ripples that are produced due to uneven motion of generator.

Step 8: From here the power is stored directly in 12v lead acid battery .

Step 9: So the 12v DC is connected to the inverter to convert it into 230AC.

Step 10: Now the voltage obtained is used for small applications.

Step 11: The display unit takes signal from battery and converts it into digital signal by ADC and transfers its data to microcontroller.

Step 12: The voltage signal thus obtained will be displayed in LCD display about how much voltage of

current is available.

BLOCK DIAGRAM

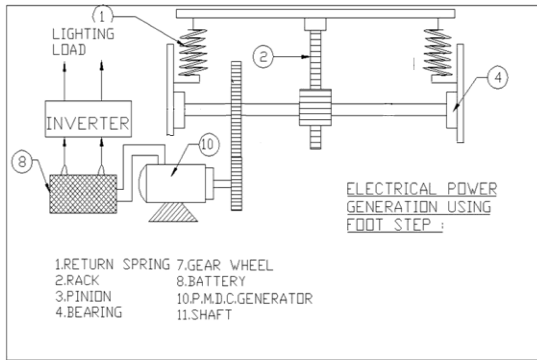


Fig: 8.1 Line Diagram for Foot Step Power Generation

IX. ANALYSIS

CHARGING TIME:

The entire energy that is produced when the load is applied on the footsteps is stored in a storage device called BATTERY. So, it is taken as important criteria to determine the charging time taken by the battery. In this project the battery is used with the battery rating of 1.3AH (ampere hour).

Charging Time = Battery Rating / Charging Current

BATTERY BACKUP TIME:

Battery Backup Time = Battery Rating / Load Applied

THEORITICAL POWER OUTPUT

To determine the output power it is essential to determine the force applied on the model. Let the force applied be calculated as,

Force = Weight Of The Body = $m \cdot g$

Work done = Force x Displacement

Power = Work done / Sec

Let the weight applied by the body is 20kgs, then the maximum displacement of the spring can be noted as 0.05m

Force = $20 \times 9.81 = 196.2\text{N}$

Work done = 196.2×0.05

i.e., work done = 9.81

Power = $9.81 / 60$

i.e., power = 0.1635

Power generated

per an hour = $0.1635 \times 3600 = 588.6\text{watts}$

PRACTICAL POWER OUTPUT

Power can be calculated in terms of obtained voltage and current when the load is applied on the footsteps. The readings are noted by using the Multimeter.

Power = Voltage x Current

Here, when the foot is depressed due to the applied load on the footsteps the calculated power is as follows.

For one step of 20kgs of load applied on the footsteps, the generated voltage is 2.6V and the average current produced is 12milliamps.

Power = $2.6 \times 0.012 = 0.0312$

Power generated per hour is $0.0312 \times 3600 = 112.3\text{Watts}$.

Thus the obtained power for continuous load applied on the footsteps for one hour is **112.3watts**.

X. ADVANTAGES

- Produces electricity efficiently.
- It is an inexpensive source of all known forms of energy.
- It does not pollute the environment.
- Automatically operates the street light when the sun falls.
- It can be easily maintained.
- Simple construction, mature technology.
- No manual work necessary during generation.
- Energy available all year round.
- No fuel transportation problem.
- No consumption of any fossil fuel which is nonrenewable source of energy.
- Reliable, Economical, Eco-Friendly.
- No need of fuel input.
- This is a non-conventional system.
- Battery is used to store the generated power.

XI. CONCLUSION

The project work “Power generation by foot step” is designed and developed successfully, for the demonstration purpose a proto type module is constructed with lower ratings of devices, & results are found to be satisfactory. As it is a demo module it

cannot be used for real applications, but the concept is near to the real working system, to make it more realistic, higher rating power generator with suitable gear mechanism is essential to produce more energy.

This concept falls under the subject of non-conventional energy resources, out of the many alternative energy resources one dependable source is solar energy, but it is quite costliest affair. Therefore alternative cheapest source is to generate electricity from foot step. This technology proven here is the ultimate inexpensive source of all known forms of energy. When it is implemented practically, depending up on the size & traffic flow, each foot step may produce tens of kilowatts power every day, this power can be utilized for many applications. If we are used this project at very busy stairs palace then we produce efficient useful electrical for large purposes. One important advantage of producing energy through this technology is that it does not pollute the environment.. Hence these foot step can be altered with this technology, there by all the street lights belongs to a particular city can be energized.

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