HARVESTING ELECTRIC ENERGY FROM FOOT STEPS

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Abstract
The human body is a bank of stored energy as we move to perform actions. We convert this stored chemical potential energy into useful kinetic energy. Proposal for the utilization of waste energy of foot power with human locomotion is very much relevant and important. 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.
The objective of analysis described herein was to develop an approach to harvest energy from the footsteps .The feasibility of harnessing electric energy using footsteps has been analysed by various methods one among such methods was using the mechanism of rack and pinion coupled with a dynamo.
Keywords: Kinetic energy, Power, Harvest energy, Footsteps, Dynamo.

I. INTRODUCTION

Walking is the most common activity in day-to-day 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.

The working principle is that it uses rack and pinion mechanism coupled with a dynamo to produce electricity. The power generated by the foot step generator can be stored in an energy storing device. This stored energy can be used continuously or whenever it is necessary. This device facilitates the generation and usage of power within the place where it is generated without dissipation and transmission losses.

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.

II. METHODOLOGY AND OBJECTIVES

The main objectives of the present study are

1. Capturing energy from everyday motion of people.
2. Clear and pollution free energy production.
3. Ensures reduction in the use of conventional energy sources.
4. Cost effective energy generation.

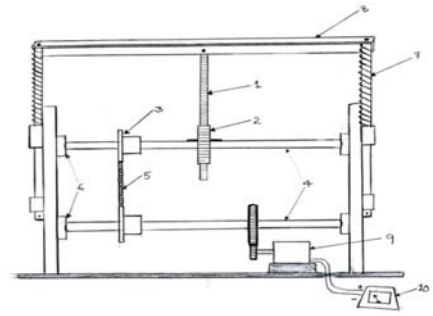

Fig 1 Schematic diagram of footstep electric generator

1. RACK
2. PINION
3. SPROCKET WITH HOUSING
4. SHAFTS
5. ROLLER CHAIN
6. BEARINGS
7. SPRING
8. ANGLE PLATE
9. 9. DYNAMO
10. 10.MULTIMETER

III. WORKING MECHANISM

When a pedestrian is walking on the arrangement the weight of his body will be

distributed uniformly on various components of arrangement such as angle plate, coil springs and vertical supports etc.

The angle plate is suspended to the vertical support by springs and cylindrical rod. The force imparted on angle plate is in turn transmitted to the rack and it actuates the rack.

The springs are held in positions between the angle plate and the vertical rods by drilling and tapping two internal threads on one end of the cylindrical rods. The cylindrical rods are held on either sides of vertical plates by hollows cylinders which are welded to the vertical supports.

The cylindrical rods provided helps to constrain the motion of rack in a vertical linear direction without any deviation from the actual path. This up and down movement is then transmitted to the pinion gear which is placed on the horizontal shaft with the help of keys. The two shafts are fitted horizontally to the two vertical supports using the flange type of ball bearings with the help of bolts.

The shaft is also provided with sprocket housing. This helps to transmit the developed motion of the pinion to the other horizontal shaft, which is provided parallel below the first horizontal shaft with the help of chain drive.

The second horizontal shaft is provided in order to reduce the vibrations due to the dynamic loading of the rack movement and also to establish smooth and efficient transmission from the first shaft to the second shaft. This shaft is provided with gear of required gear ratio, which is meshed with the gear provided on the dynamo to multiply the output of the device. The output of the dynamo is stored in a rechargeable battery and used whenever necessary.

IV. MATERIALS USED

The main material used in the project is an unalloyed medium carbon steel. It is an unalloyed medium carbon steel grade with reasonable tensile strength.

The specification according to BS970 1995

EN8 STEEL

Where EN stands for “Europaischen Normen”

It is normally supplied in the cold drawn or as rolled condition. EN8 is a very popular grade of through-hardening medium carbon steel, which is readily machinable in any condition. Tensile properties can vary but are usually between 500-800 N/mm² and elongation percentage 16.EN8 in its heat treated forms possesses good homogenous metallurgical structures, giving consistent machining properties. EN8 can be flame or INDUCTION HARDENED to produce a good surface hardness with moderate wear resistance. EN8 is available from stock in bar and can be cut to your requirements. We also offer flame cut plates cut to your required sizes and normalized. EN8 plates can be supplied surface ground or precision ground.

EN8 is widely used for many general engineering applications. Typical applications include shafts, studs, bolts, connecting rods, screws, rollers.

The main composition of EN8 is

Carbon	0.35 - 0.45 %
Manganese	0.60 – 1.00 %
Silicon	0.05 – 0.35 %
Phosphorous	0.015 - 0.06 %
Sulphur	0.015 - 0.06 %

This material is also designated as per BS970 as “080M40”

The BS970 code number is constructed as follows:

a) The first three symbols are a number code indicating the type of steel:

000 to 199 Carbon and carbon-manganese steels. The number represents the manganese content x 100

200 to 240 free cutting steels. The second and third number indicate the sulphur content x 100

250 Silicon Manganese valve steels

300 to 499 stainless and heat resisting steels

500 to 999 Alloy Steels

b) The fourth symbol is a letter code.

A steel is supplied to a chemical composition determine by analysis of the batch sample.

H The steel is supplied to a hardenability specification.

M The steel is supplied to a Mechanical Property specification.

S The steel is a stainless steel.

c) The fifth and sixth symbol is a number is the actual mean carbon content x 100This EN8 steel is used in our project for the manufacturing of Rack and Pinion, Vertical supports, Shafts, Cylindrical rods.The gears mounted on the second horizontal shaft and dynamo are made of mild steel. It is the most common form of steel. It is a low carbon steel. Mild steel is a carbon steel typically with a maximum of 0.25% of carbon and 0.4-0.7% of

manganese 0.1-0.5% of silicon and small traces of other elements such as sulphur, lead, phosphorous etc. The springs are made of spring steel. The entire setup is placed on a wooden platform. Spring steel is also commonly used in the manufacture of metal swords used for stage combat due to its resistance to snapping or shattering. Spring steel is one of the most popular materials used in the fabrication of lock picks due to its pliability and resilience. Tubular spring steel is used in some of the smaller aircraft's landing gear due to its ability to absorb the shock from landing & also acts like damping. Applications include piano wires, spring clamps, antennas, and springs.

Model

Fig: 2 Front view of the footstep electric generator

Fig 6.2 Side view of the footstep electric generator

Table 1: Specification of Parts

S. NO	PART	MATERIAL	QTY	DIMENSIONS (mm)
1	RACK	EN8	1 NO	30mm long
2	PINION	EN8	1 N0	ϕ 68.5 No.of teeth=26
3	SHAFTS	EN8	2 NO'S	ϕ 20mm 610 mm long
4	VERTICAL SUPPORTS	EN8	2 NO'S	ϕ 14 mm
5	STEEL SPRINGS	SPRING STEEL	2 NO'S	2mm thick 152mm long Stiffness= 7.5 N/mm
6	BEARINGS	CHROME STEEL	4 NO'S	ϕ 20mm
7	FREE WHEELS AND HOUSING	STEEL	2 NO'S	ϕ 45mm
8	DYNAMO		1 NO	12V

TESTING AND RESULTS

If the device is installed in a public area, for an instance in a shopping mall the amount of power generated for a certain can be formulated as follows

Let us consider average number of persons entering the shopping mall per one hour be 300 and the average load acting on the device be 30kgs.The voltage generated when 30kgs load acting on device is 4 volts.

The field coil resistance of the dynamo is a constant value of 1.5 ohms.

When analyzed for different load conditions the footstep electric generator gave the following results

FOR DIFFERENT LOADS APPLIED ONE TIME:

Table 2: Voltage generation for different loads

LOAD (in kg)	VOLTAGE GENERATED (in Volts)
20	2.5
30	5
45	8
50	10

FOR CONSTANT LOAD APPLIED NO. OF TIMES:

Table 3: Voltage generation for constant load applied

LOAD (in kg)	NO. OF TIMES LOAD APPLIED AND REMOVED	VOLTAGE (in Volts)
20	1	2.5
20	2	5
20	3	7.5
20	4	10

The instantaneous power generated by the device can be given by

$$\text{Power} = \text{Voltage (V)} \times \text{Current (I)}$$

$$= (V \times V) / R \quad \text{where R = Resistance}$$

Instantaneous power generated when load of 30 kg acts on the device is

$$\text{Power} = (4 \times 4) / 1.5 = 10.66 \text{ watts}$$

So, the total power generated in the duration of one hour is

$$= 300 \times 10.66$$
$$= 3198 \text{ watts}$$

V. ADVANTAGES AND DISADVANTAGES

ADVANTAGES

1. Power generation is simply walking on the step
2. Power also generated by running or exercising on the step.
3. No need fuel input
4. This is a Non-conventional system
5. Battery is used to store the generated power

DISADVANTAGES

1. Only applicable for the particular place.
2. Mechanical moving parts is high
3. Initial cost of this arrangement is high.
4. Care should be taken for batteries

VI. APPLICATIONS

Power generation using footsteps can be used in most of the places where people move all around the clock such as air, bus, railway terminals. They are also used to light up street lights, LED light for specific purposes and used in security alarm, for air circulation system for room by the small fans.

VII. CONCLUSIONS

The problem of energy crisis arises due to increase of population and also over dependency on the major power generation projects, which are available in a merge numbers, due to large initial investment capitals, maintenance and non -availability of huge deposits of resources at one particular place. So there is a need to focus on minor power generation alternatives.

This project of ours is one such alternative energy production source which is generally referred as “Distributed generation”. Distributed generation, also called on-site generation, dispersed generation, embedded generation, decentralized generation, decentralized energy, distributed energy or district energy, generates electricity from many small energy sources

The generation of power does not require huge capital investment or does not use of any fuels

or electrical input. It is easy to construct and maintenance is very less .It occupies less space and can be built in place where there is a requirement of power.

Even though it may not generate large quantities of electricity it may reduce the dependency on major projects to a certain extent. This type of power generation will be handy if we use this project at very dense human traffic then we produce efficient useful electrical for large purposes.

REFERENCES

[1] Machine design by R.S.Khurmi
[2] Machine design by J.E.Shigley
[3] Sharma.P.C , Principle of renewable energy systems.
[4] Sharma.P.C, Non-Conventional power plants
[5] Mukherjee. D Chakrabarti.S, Non-conventional power plants.
[6] Ankita, MeenuBala, Power Generation From Foot steps, International Journal Of Advance Research In Science and Engineering.
[7] Websites
[8] www.howstuffworks.com
[9] www.answers.com
[10] www.techno-preneur.net
[11] www.telegraph.co.uk/.../energy/.../Japan-harnesses-energy-from-foot