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A Proposed Method to Generate Electricity through Power Stair

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ABTRACT: *We are using the non-renewable energy sources such as petroleum as well as renewable sources like solar, wind, tidal power etc., but still we couldn't overcome our power needs. So we have to generate electricity through each and every possible ways. Power can be generated through we are stepping on the stairs; the generated power will be stored and can be used for domestic purposes. This system can be installed at homes, colleges, railway stations, where the people move around the clock. The utilization of waste energy of human foot power is very much relevant and important for populated countries like India and China. A special mechanical arrangement such as crankshaft mechanism is employed on the stair case. This arrangement will convert the foot power applied on stairs, as a rotary motion. This rotary motion will be used to generate efficient electricity. It's an eco-friendly; easily accessible and non-conventional power generation system when compared to existing systems.*
Keywords: *crankshaft mechanism, foot power, non-conventional power generation system, rotary motion, stair case*

I. INTRODUCTION

This attempts to show how energy can be used at a commonly used floor steps. The usage of steps in every building is increasing day by day. Even every small building has some floors. A large amount of energy wasted when we are stepping on the floor by dissipation of heat and friction, every time a man steps up using stairs, there is a great possibility of tapping this energy and generating power by making every staircase as a gear power generating unit. The generated power can be stored by battery and it will be used for lightening the building.

II. AIM OF THE RESEARCH

This method generates the electric power without polluting our environment. The waste energy supplied by human is utilized in this system. The energy source is continuous and renewable. Moreover we are confident that this method of power generation will be used for rural electrification and to fulfill our power needs. Also this system looks very eco-friendly from the environmental point of view.

III. LITERATURE REVIEW

- An investigation on generation of electricity using foot step 2015 Siba brata Mohanty, Sasank Shekhar Panda, Research scholar, Department of Industrial Engineering, G.I.E.T, Gunupur. Rayagada, India Research scholar, Department of Mechanical system Design, G.I.E.T, Gunupur. Rayagada, Odisha.The objective of this work is power generation through footsteps as a source of renewable energy that we can obtained while walking on to the certain arrangements like footpaths, stairs, Plate forms and these systems can be installed elsewhere specially in the dense populated areas. The basic working principle of 'footstep power generation system' is based on the crank shaft and gear arrangement and fly wheel.

- Design of energy capturing medium using piezoelectric effect 2015 S.Krishna, S.Vignesh Jeppiaar Engineering College, Sri Sairam Engineering College. Piezoelectric materials (PZT) offer a promising approach as an efficient method to reduce our dependence on conventional source of electricity. Besides the power generation through piezoelectric materials being a non-conventional approach, helps to reduce the environmental pollution.

- A Proposed Method of Foot Step Power Generation Using Piezo Electric Sensor 2015 Mr.A.Adhithan, K.Vignesh, M.Manikandan, Assistant Professor, Department of EEE, Adhiparasakthi Engineering College, Melmaruvathur UG-Final Year, Department of EEE, Adhiparasakthi Engineering College, Melmaruvathur. The objective of this work is power generation through footsteps as a source of renewable energy that we can obtained while walking on to the certain arrangements like footpaths, stairs, plate forms and these systems can be install elsewhere specially in the dense populated areas.

IV. RESEARCH METHODOLOGY

The human load acts upon the staircase produces linear reciprocating motion on the power step. Here the reciprocating motion of the power step was converted into rotary motion using the connecting rod and flywheel arrangement. A flywheel was used to produce rotary motion. The flywheel and the power step pedal are connected by means of connecting

rod. The rotary motion of large flywheel was given to the small pulley by belt drive. Hence the speed that was available at the flywheel is relatively multiplied by the rotation of the smaller pulley. This speed was sufficient to rotate the rotor of the dynamo. The rotor which rotates within a static magnetic stator cuts the magnetic flux surrounding it, thus producing the electro motive force (emf). This current was then used for lighting purpose. The dynamo converted the mechanical rotary motion into electrical energy.

Here electricity is generated by the help of load application upon the staircase used in the project. To make this possible a staircase model has been constructed which has two steps out of which one is stationary one while the other is the power step. The name power step so called because when the load is applied on it by means of human footstep electricity is generated. To generate electricity by means of power step various arrangements has been done. The power step is supported by means of two helical springs which provide proper position to the step by retaining the original position after the application of load on the power step. A connecting rod is provided whose one end is connected with the step while the other end is connected with the flywheel, so that downward movement of the ower step makes the flywheel to rotate. Another small pulley is coupled with the flywheel by means of belt drive, so that when the flywheel rotates the pulley also rotate. We use a dynamo for converting the mechanical input into electrical output. Here the mechanical input is the shaft power of the dynamo and electrical output means we generate electrical power. This is achieved by fixing the dynamo shaft with the small pulley, so that with the rotation of the pulley the dynamo shaft also rotate and we get the output electrical power through generator.

V. ANALYSIS OF THE COLLECTED DATA

We know that the springs are used for storing energy which is equal to work done on it by some external load.

Let, W = Load applied on the spring = mg

δ = Deflection produced in spring due to load W

Assuming that load is applied gradually, the energy stored in the spring is

U= ½ W × □…… Equation (1)

As previously mentioned that energy stored in spring = work done on the spring by the external Load. Now,

work done per cycle = U × N 60…….. Equation (2)

Where, N = RPM of the flywheel

Work done per cycle of a flywheel is given by the formula = T mean × □…… . Equation (3)

Where, T = Mean torque

θ = angle turned in radian per revolution = 2π

Equating equation (2) & (3)

T mean can be obtained. Again the mean torque (Tmean) in N-m may be obtained by using the following relation

i.e. **T mean = P×60/ 2□ n…….…… Equation (4)**

Where, P = Power transmitted in watt

N = Speed in RPM

From equation (4) power transmitted from flywheel to the dynamometer shaft is obtained which can be given by the formula

P= 2 □NTmean/ 60……. Equation (4.1)

This is the power that finally developed at the dynamometer shaft which is used for the generation of electricity. So this is the electrical power. The electrical power is given by the formula

P = V /2 × R……..….. Equation (5)

Where, P=Power

V=Voltage

I=Current

From equation (5) the voltage generated by the staircase can be obtained and is given by,

V= □PR…… Equation (6)

Where, R=Resistance

5.1 Test Procedure

- For testing first of all take a load of **W** kg on the power step.
- Due to this load the step moves downward due to spring. Then measure the downward displacement of the spring by means of a steel rule.
- The downward movement of the spring causes the flywheel to rotate. And the speed of the rotation of the flywheel in rpm is measured by means of a tachometer.
- This causes the dynamo to generate electricity as the dynamo shaft is fixed with the small pulley which is coupled with the flywheel by belt drive.
- Then the voltage and power is measured by means of a multi meter.
- Equipments used: - Tachometer, Multi meter.

5.2 Sample Calculation

Mass (m) = 14 kg

Load (W) = 14 × 9.8 = 137.2 N

Deflection (δ) = 0.02 m

Speed (N) = 30 rpm

Resistance(R) = 12 Ω

By putting the above values in equation (1) we get energy stored,

U = ½ W ×δ = 2 ×137.2×0.02=1.37 J From equation (2)

Work done per cycle = (U×N)/60
= 1.37×30/60
= 0.686 watt

From equation (3) work done per cycle of the flywheel = T mean ×2π
⇒ 0.686 = Tmean×2
⇒ Tmean=0.682 π
⇒ T mean = 1.07 N-m

Power transmitted to the dynamometer shaft can be obtained from equation 4.1,

i.e. $P = 2\pi NTmean60$

$\Rightarrow P = 2\pi \times 30 \times 1.07$

$\Rightarrow P = 3.4$ watt

Voltage is calculated from equation (6)

$V = \sqrt{PR} = \sqrt{3.4} \times 12$

= 6.38 volt

VI. PRESENTATION OF THE RESULTS

TABLE -1	
LOAD VS SPEED	
LOAD in kg	SPEED in rpm
0	**0**
11.5	**25**
12	**26.9**
12.5	**28.5**
13	**29.2**
13.5	**29.6**
14	**30**

TABLE -2	
LOAD VS VOLTAGE	
LOAD in kg	VOLTAGE in Volts
0	**0**
11.5	**3.12**
12	**3.42**
12.5	**4.3**
13	**4.82**
13.5	**5.04**
14	**5.12**

TABLE -3	
LOAD VS POWER	
LOAD in kg	POWER in Watts
0	**0**
11.5	**2.1**
12	**2.3**
12.5	**2.5**
13	**2.7**
13.5	**2.75**
14	**2.8**

VII. DISCUSSION

The power is measured in watt, voltage in volt and speed in rpm. To obtain different values of power, voltage and speed the loads are applied in kg. It had been seen that the values of speed, power and voltage increases as the load is increased. So higher the load higher will be the power generated. After getting all the values we calculate the theoretical voltage. By comparing both theoretical and actual voltage we had seen that the actual power is 80 percent less than the theoretical power.

The graphs are plotted between "Load vs. Speed", "Load vs. Voltage" and "Load vs. Power" as shown in fig.1, fig.2 and fig.3 respectively. It is observed from the graphs that there is linearity between the two respective parameter of the graph but a loop is encountered when the load varies from 12 to 12.5 kg. After that it has been seen that again there is linear it occurred between the two parameter of the graph with the increasing load. We had applied the maximum load as 14 kg at which the speed, power and voltage obtained are 30 rpm, 2.8 watt and 5.12 volt respectively.

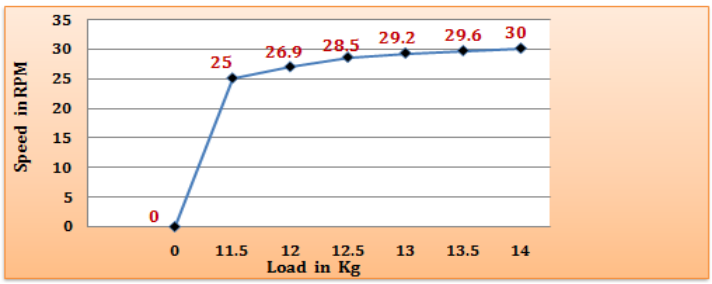

Fig. 1: Relationship between Load and Speed

The relationship between loads vs. speed is shown by the graph where load is presented on X axis and speed on Y axis. Now from the graph it is seen when the initial value of load is 11.5kg and speed is 25 rpm. The load is increased from 11.5 kg to 12 kg and speed from 25 to 26.9 rpm and one by one load is increased with respect to speed, There is one point where load is 12.5 kg and speed is 28.5rpm one loop occurred then again the load increased from 12.5 to 13 Kg and resulting speed varies from 28.5 to 29.2 rpm again there is a linearity between load and speed. Finally the relation between load and speed is linear.

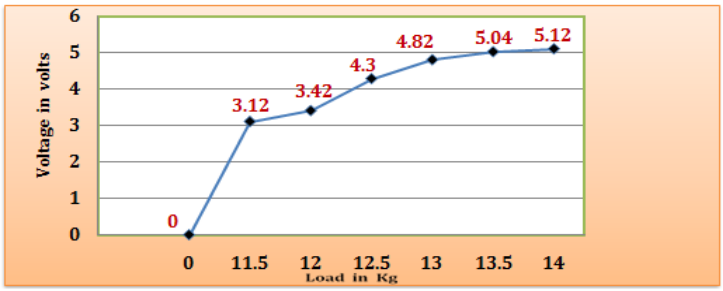

Fig. 2: Relationship between Load and Voltage

The relationship between loads vs. Voltage is shown by the graph where load is presented on X axis and Voltage on Y axis. Now from the graph it is seen when the initial value of load is 11.5kg and Voltage is 3.12V. The load is increased from 11.5 kg to 12 kg and voltage from 3.12V to 3.42V and one by one load is increased with respect to voltage, There is one point where load is 12.5 kg and Voltage is 4.3V one loop occurred then again the load increased from 12.5 to 13 Kg and resulting voltage varies from 4.3V to 4.82V, again there is a linearity between load and voltage. Finally the relation between load and voltage is linear.

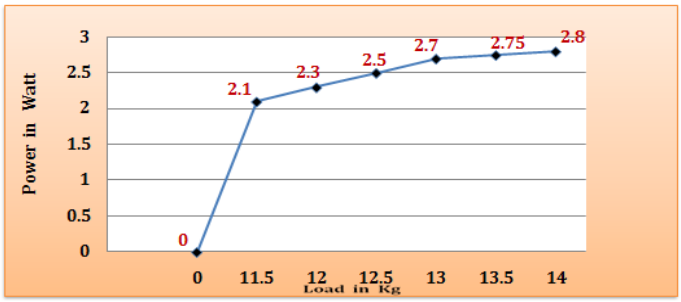

Fig.3: Relationship between Load and Power

The relationship between loads vs. power is shown by the graph where load is presented on X axis and power on Y axis. Now from the graph it is seen when the initial value of load is 11.5kg and power is 2.1 watt. The load increased from 11.5 kg to 12 kg and power from 2.1 to 2.3 watt and one by one load is increased with respect to power, There is one point where load is 12.5 kg and power is 2.5 watt one loop occurred then again the load is increased from 12.5 to 13 Kg and resulting power is varies from 2.5 to 2.7 watt again there is a linearity between load and power. Finally the relation between load and power is linear.

VIII. CONCLUSION

This method generates the electric power without polluting our environment. The waste energy supplied by human is utilized in this system. This energy source is continuous and renewable. Moreover it is concluded that method of power generation will be used for rural electrification and to fulfill our power needs. Also this system looks very friendly to the environment. The electricity can be generated through staircase in the crowded places like railway stations, bus stations and all the major sub stations where people make lots of crowd while climbing up and down through the staircase. Here we have shown that how much power is being generated per person while stepping on the power step and how much load is required to generate electricity in the spring loaded staircase. This project can be implemented in the places where there is shortage of electricity or the rural areas mostly.

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