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Power Generation from Dance Floor

(A Mechanism Design using Rack and Pinion)

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***Abstract*—The electrical power is produced with non-conventional method by simply jumping or dancing on the floor. Non-conventional energy system is very essential in this era of time to our world. It provides energy in the useful form from the input of the form of the energy that is not useful. Plus, it provides energy without causing any trouble to the nature or causing global warming. It is similar to foot step power generation. Non-conventional energy using foot step is converting pressure energy into the mechanical energy & then after into the electrical energy. The main aim is to develop much cleaner cost effective way of power generation method, which helps to bring down the global warming as well as reduce the power shortages. The mechanism contains the rack & pinion and dynamo. The pressure energy is imparted on floor by the human. This pressure energy is converted into mechanical energy with the help of rack & pinion mechanism. The mechanical energy is further transferred to the dynamo for the conversion into electrical energy with the help of speed conversion gears, chain and sprockets and the ratchet mechanism. There are some extra objects and mechanisms are used to minimize the energy waste during the transformation of energy from one place to another. Such as ratchet mechanism.**

Keywords*— *Rack; Pinion; Sprocket; Chain; Pedestal Bearing; Ratchet Mechanism; Nonconventional Method For Energy Conversion

I. INTRODUCTION

In some of the developing countries, there are several hours of daily power-cuts in rural areas as well as in urban areas like metro cities due to the increase in demand of electricity that cannot meet the increase in production of electric power. As a result, people in these countries are forced to use a power-inverter and/or rechargeable batteries or a diesel/petrol-run electric generator during the power-cut. The use of generators is common in industries, but it is unusual to utilize it at home. Because of the cost to run the diesel/petrol-run electric generator is high. Besides, it also causes pollution which increases global warming. So we proposed the method which can be a help in smaller scale to save the power in the urban areas like metro cities. And the power saved by this method can be used to light up the rural areas [2] [3].

In the future, there are chances of having more number of methods available to produce the electricity by nonconventional method. The recent technology is concentrated on the increasing the efficiency of the equipment used for the nonconventional method power generation. Increasing the efficiency includes the increase in the amount of generating electricity with the same or less amount of input energy that is used prior. To develop a method which is economically suitable for the mass production of the power generation by nonconventional method is a challenge [1] [3].

In the past, several substitutions were proposed for generating electricity at the smaller scale. Here we are using the mechanism of rack and pinion where power generation takes place with the use of mechanism that generates the power from the energy/force of the people produced by walking or dancing on the floor. This technique can be used in the areas where consumption is high such as city areas [1].

II. PROPOSED TOPOPLOGY

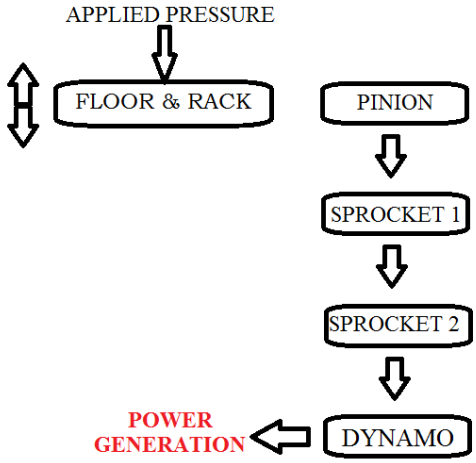

Fig. 1. Proposed Power Generating Mechanism

This method of electricity generation can be divided into two parts. First, the conversion of waste energy that is produced by human into useful mechanical energy and then the mechanical energy into electrical energy. The pressure energy that is produced due to the walking or dancing on the floor is converted into mechanical energy by using of rack and pinion mechanism. Then generated rotational/mechanical energy is used to produce electric power by using dynamo.

In the first part of energy conversion, the pressure energy generated by the walking or dancing on the floor by the people is converted into vertical motion of the dance floor with the help of the springs. And there is a rack fixed to the floor, which helps to convert the vertical linear motion into the rotational motion with the assistance of pinion attached to it [6] [7].

Furthermore, this mechanical energy is transferred to the dynamo with the help of speed increasing gears and ratchet mechanism. And the dynamo is used to generate the power. The total power generated by the mechanism depends on the

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number of rack and pinion mechanism used and the quantity and type of dynamo taken in use [6] [7]. There is a battery provided for the storage of the power.

III. MECHANISM DESIGN

The work flow of generating power from the dance floor begins with the design of spring which is followed by the rack and pinion. Which is furthermore followed by the design of chain and sprocket mechanism. There is a ratchet mechanism provided in the second sprocket for controlling the energy wastage during the transfer of the energy to the chain and sprocket mechanism. There are pedestal bearings used to hold the rotating shaft. The design of different parts utilized is stated below.

A. Spring

Spring is device which is used to store energy and absorb the shocks. For example, in jumpers of automobile vehicles, in industrial machineries etc. [4] And here, it is most essential part among all. Because the amount of the vertical distance the floor travels is being controlled by the spring. And the amount of vertical distance decides the number of rotations pinion will rotate. Furthermore, the rotations of pinion is the energy that is transferred to the dynamo as input energy. So output rely on the design of spring.

There are several types of spring available. It is defined as per the utilization of spring. Such as, Helical Spring, Torsion Spring, Conical Spring, and Leaf Spring. Torsion Springs have hooks at the both ends, which are used to hold the objects. For example, in door locks. Conical Spring is useful in the place where one end is large and other end is small. For example, a bore and rod combination. Leaf Springs are used for heavy loads like trucks and heavy machineries [6] [7]. Here, Helical Compression Springs are used. The objective of this spring is to push back the dance floor to its original position after it reaches its maximum downwards position. In short, spring is used to control the vertical movements of the floor.

The Deflection of the spring, Stress allowances of the material, the Bending stress all formulas are stated below [4] [6] [7].

TABLE 1. Formulae

Terms	Formulas
Spring deflection	$s = \frac{8 \cdot F \cdot n \cdot D^3}{G \cdot d^4}$
Torsional stress of the spring material	$\tau = K_s \cdot \frac{8 \cdot F \cdot D}{\pi \cdot d^3}$
Spring constant	$k = \frac{G\, d^4}{8 \cdot n \cdot D^3}$
Curvature correction factor	$k_s = f\left(\frac{D}{d}\right)$

Where,

d = wire diameter [mm, in]
D = mean spring diameter [mm, in]
F = loading of spring [N, lbs.]
G = modulus of elasticity in shear [MPa, psi]
N = number of active coils

The material used for the spring is Medium Carbon Spring Steel of IS 4454 grade 2. The material has ultimate tensile strength and the modulus of rigidity of 1500 MPa and 80,000 N/mm^2 respectively [4]. The measurements of spring used in the prototype are as below.

Number of springs, n = 4
Mean Spring Diameter, D = 61.5 mm
Wire Diameter, d = 6.5 mm
Free Length, l = 330 mm
Number of Active Coils, N = 9
Modulus of Rigidity, G = 80,000 N/mm^2
Ultimate Tensile Strength, S_{ut} = 1500 N/mm^2
Force, P = 1140 N
Deflection, s = 133.70 mm

B. Rack and Pinion

Rack and pinion is the mechanism which is used to convert the vertical movement/linear motion of the rack into rotational motion of pinion. This rotational motion is utilized as input energy to produce the electric power from the dynamo [6] [7].

The material of Rack and Pinion is Mild Steel. The cost of the material is less and by considering the life cycle of the mechanism, it is cost effective. Moreover, the stresses that can be bear by the mechanism due to the material is good enough.

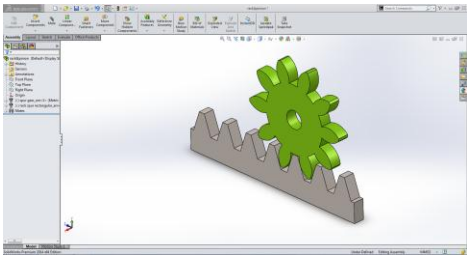

Fig. 2. RACK AND PINION MECHANISM

There is a guided pulley required to support the vertical motion of the rack. The pulley is required because of the centrifugal force created by the rotation of pinion. And that force causes torque. The amount of torque which can exceed the welding joint between the rack and the floor. In addition to that, the rotation of the bearing helps to reduce the friction and the energy wastage caused due to friction.

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Fig. 3. Guided Pulley

The dimensions for the Rack used in the prototype are as below.
Length = 431.8 mm
Module = 10 mm
Face Width = 12 mm

The dimensions of the pinion used in the prototype are as below.
Module = 10 mm
Number of teeth = 15
Face Width = 12 mm
Diameter = 16 mm

C. *Chain and Sprocket Mechanism*

The chain and sprocket mechanism is used to transfer the rotational energy to the dynamo. In addition to that, it is also used to increase the rotation energy with the help of speed increasing gears and gear ratios [6] [7].

There is a sprocket with higher number of teeth attached to the other end of the shaft which has pinion on the one end. And with the help of chain, the rotation is transferred to the second sprocket which has lower number of teeth. Thus, the input rotations to the dynamo is increased.

However, there is one problem along the way during the energy production. If when rack moves downwards, the output shaft of the mechanism rotates clockwise direction, then when rack moves upwards, the output shaft of the mechanism will be rotating in anticlockwise direction. As a result, it eliminates the power produced by the one side of rotation in dynamo. To overcome this problem, there is ratchet mechanism provided on the second sprocket [6] [7]. This mechanism helps to filter the rotations of both clockwise and anticlockwise direction to the one side rotation either the anticlockwise or clockwise direction. The advantage of this mechanism is that, it eliminates one type of rotation. The second sprocket can rotate in both the direction, but the output shaft can rotate can rotate in only one direction. So dynamo gets only one sided rotation energy i.e. either clockwise or anticlockwise. In addition to that, it allows the output shaft of the chain and sprocket mechanism to rotate freely when the other type of rotation is taking place. That means, if when rack moves downwards and output shaft of mechanism rotates clockwise, then while rack moves upwards the rotation of output shaft will not be effected and will be continued and it will decrease due to the friction between the different parts. This is how dynamo will get one directional rotational input and can produce the power.

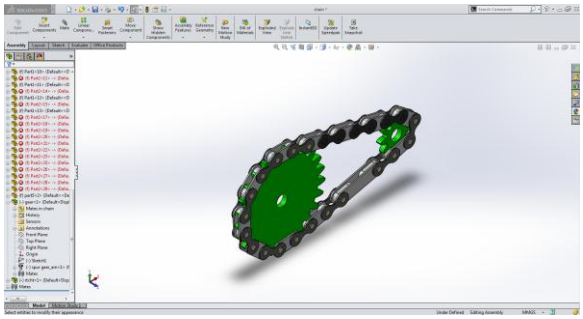

Fig. 4. Chain and Sprocket Mechanism

The measurements of the sprocket 1 used in the prototype which is attached to the pinion are stated below.
Module = 6 mm
Number of teeth = 55
Face width = 8 mm
Diameter = 240 mm

The measurements of the sprocket 2 used in the prototype are stated below.
Module = 5 mm
Number of teeth = 25
Face width = 8 mm
Diameter = 40 mm

D. *Pedestal Bearing*

Pedestal bearings are the devices for the housings of the rotational shafts. It contains a bearing and the case which mount the rotating shaft and bearing. It is generally used for lower amount of loads in industry [3].

The terms like Pedestal and Plummer block are used in certain parts of the world. The fundamental application of both types of Pedestal is the same, which is to mount bearings with their outer ring which stays stationary while allowing rotation of the inner ring. The housing is bolted with base plate. The material used to make bearing housings is mostly grey cast iron [2] [3].

The rotation of the bearing inside the bearing housing is captured by a snug at the bottom of the brass. The cap is fitted on the pedestal block by using of bolts and nuts [2].

Fig. 5. Pedestal Bearing

E. *Dynamo*

Dynamo is a device which is used to convert the rotational/mechanical energy into electrical power. The current produced by the dynamo is Direct Current. It is the primary form of power generation due to its reliability and efficiency of the system. Mechanical commutator the dynamo has is the disadvantage of the system [1] [3].

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The dynamo includes rotated coils of wire and magnetic fields which assists in converting mechanical rotation energy into a direct current. It works on the Faraday's law of Induction [5]. A magnetic field is produced by the stator or magnets, which is placed in the dynamo and rotating wires called the armature rotates in that field. Because of the rotary motion of the armature in the magnetic field, it pushes the electrons of the material of the armature, which results into production of electric current in it [3].

The commutator is a part of the dynamo which moves continuously. It changes the current direction between the rotor and the external circuit periodically. Metal contact segments are used to make it in order to pass the current through it. It is called brushes which makes sliding contact with each segments with the rotations. And coil on the armature is connected to it. Commutators are relatively inefficient, and also require periodic maintenance such as brush replacement. So the use of commutated machines is decreasing [2] [3].

Fig. 6. Dynamo

IV. EXPERIMENTAL RESULT

The performed project is to generate electricity by nonconventional means and I am fairly satisfied with the outcome as the expected generation was assumed to be about 10-12 watts as per the previous researches [1] [2], though I was not able to reach the expected mark due to insufficient funds and inadequate knowledge but was successful in producing about 3-4 watts of power in every performed trials. The generated electricity is then stored in a battery so that the electricity can be used in future or could even be used to operate various appliances simultaneously as the experiment is performed.

This generated energy is the best example of utilizing the human energy that is generally wasted in the form of dance or jumping which is a trend now a days and so to use it wisely to produce and store energy in the form of electricity which could be the best example of nonconventional source of energy.

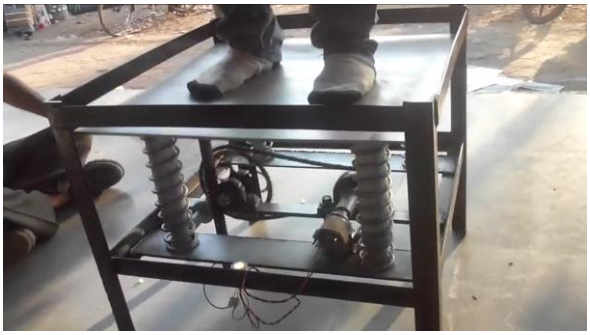

Fig. 7. Prototype

V. CONCLUSION AND FUTURE SCOPE

To recapitulate, it can be concluded that this power generating method is nonconventional and the power generated from the waste energy by this method can be useful in the urban areas where power shortage is the regular concern. In addition, there are several scopes and improvements which can probably improve the results and will be helpful in the future.

First, the number of rack and pinion mechanism can be increased according to the space available. Therefore, number of dynamos increases too. As a result, power produced can be increased. Second, there are various types of power generators available which produces power through rotational input. There are wide range of the dynamos and motors and generators available. So the amount of producing power by each of the dynamos or motor or generator in the mechanism can be increased also by having equipment suitable to the system.

Apart from the disco clubs, there are several places where this method can be used to utilize the waste energy to produce the power. For example, in gym and samba classes, in footpaths and shopping malls etc.

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