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FOOTSTEP POWER GENERATION BY RACK AND PINION

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Abstract: *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. We have used rack and pinion mechanism to produce the electricity.*

So, this kind of Footstep power Generation can be converted into electrical energy and we can generate the power without any external fuel and generate the power which is wasted on the road. So, the whole human/bio-energy being wasted if it can be made possible for the utilization it will great indentation and this type of crowd energy frames will be very useful energy in most crowded country like INDIA and CHINA

Keywords- *Foot Step Power Generation, Rack and Pinion, Gears, Dynamo, Chain Sprocket, Spring, Supporting Structure.*

I. INTRODUCTION

Most of the cities and towns in India are highly polluted. In India there are presently close to 19 million petrol powered two wheelers and about 1.7 million petrol and diesel-powered three-wheelers and their population is growing at rate of about 15% per annum. Recent incident of banning of six seated diesel tempos in Pune attests to this pollution problem. There is therefore an urgent need to introduce in cities and towns of India an environmentally sound transport system which is cost effective and which provides large scale employment for urban and rural poor. An electric cycle rickshaw can provide a non-polluting, point-to-point and a very silent transport system for urban and rural areas of India. Besides it is a very energy efficient and cost effective vehicle. Work done at our Institute has shown that improved cycle rickshaw powered by an electric motor and batteries has a potential to provide an attractive alternative to petrol and diesel-powered. We provide high, medium and low gears for plane road, rough road and slopes. We also provided this tricycle with self-charging concept.

Our Design of Tricycle is
- Extremely reliable
- Highly maneuverable
- Comfortable easy ride
- Very economical to run
- Simple to maintain

II. RECENT SCENARIO ABOUT FOOT-STEP POWER GENERATION

In our process of energy production, there are no carbon emissions that is harmful to the environment. Investing in this type of source inspire sectors of green energy to capture waste energy. A startup called emerging pavegen installed this kind of energy generating piezoelectric sidewalk squares in London. In London, Table tennis Victoria underground station is provided with the piezoelectric floor to convert thousands of traces in electrical energy.

We use the existing mechanism of the piezoelectric sidewalk to produce more cheaply amount of energy with maximum efficiency. This type of electrical energy could be stored by lithium polymer batteries contained in slabs or passed on to lampposts or other electronic devices nearby. This type of model is made from car tires recycled stainless steel and recycled aluminum, also includes a lamp incorporated in the floor that lights up each time a step is converted into energy (it only uses 8-10 percentage of energy produced.)

III. WORKING OF FOOT STEP POWER GENERATION SYSTEM

The principle of full operation of the step energy generation system is shown in figure 1. The attendance of pressure force or the weight of the vehicle is converted into electrical energy via the appropriate drive. The spring assembly and rack and pinion mechanism is fixed in this arrangement some inclined step. The spring is used to provide the return movement of the actuators by releasing the load.

The pinion shaft is connected to the end of the frame by means of end bearings as shown in Figure 1. In this arrangement, the large gear is connected to the pinion shaft which is running at the same speed of the pinion. In gear mechanism there is problem of anti rotation of the gear due to spring return motion so there is requirement of anti rotating device. But we have introduce the new mechanism in spite of gear mechanism and replace gear mechanism by chain and sprocket mechanism which is eliminate the requirement of the anti rotating device and although power generated will be more than previous case. Now with help of chain sprocket mechanism we can easily transmit the rotation to the second driven shaft. This shaft has one gear pair which will increase the gear ratio and give more rotation to the shaft and vice versa to the dynamo. So in this case dynamo can generate the more voltage up to the 24 volt and above.

Figure 1. Model of Footstep Power Generation System

IV. BLOCK DIAGRAM OF FOOTSTEP POWER GENERATION

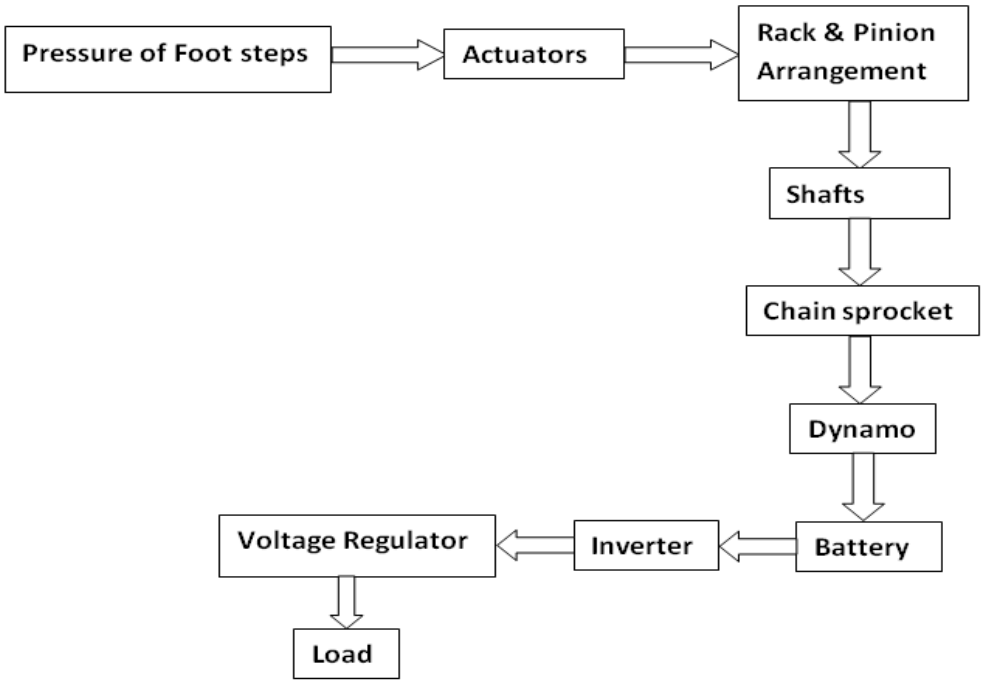

Figure 2. Block Diagram of Footstep Power Generation System

V. TECHNICAL SPECIFICATIONS OF FOOTSTEP POWER GENERATION

Table 1. General Specification

Frame	470mm X 250 mm X 340mm
Frame Material	Mild steel
Rack	268 mm X 26.5 mm X 20 mm
Expected Weight	60 kg
Actuator Plate	200 mm X 40 mm X 340 mm
Shaft (X2 Nos.)	Ø20 mm X 321 mm
Chain & Sprocket	Material : Mild Steel
Bearing Type	Y – Bearing 15 mm (X 4)

Table 2. Rack & Pinion Arrangement

Rack Dimension	268mm X 26.5 mm X 20 mm
Rack & pinion Material	Mild Steel
Pinion Dimension	No Of Teeth z= 18 Inside hole Diameter = 8 mm Module m =2 Width = 25 mm

Table 3. Spring Specification

Spring Type	Compression Helical Spring
Spring Material	Steel Wire SWG 10 (3.251 mm)
Allowable Shear Stress	385 MPa
Modulus Of Rigidity(G)	80 KN/m^2
Modulus Of Elasticity (E)	210 KN/mm^2
Free Length (L_F)	140 mm

Table 4. Gear Arrangement

Sun (Larger) Gear S	Gear Dimension : Ø282 mm X 10 mm Number Of Teeth : 280 Module m : 1
Sun Gear S Material	Mild Steel
Planet (Smaller) Gear P	Gear Dimension : Ø16 mm X 15 mm Number Of Teeth : 14 Module m : 1
Planet Gear P Material	Mild Steel

Table 5. Electrical System

Motor Dynamo	**12 V**
Battery	SLA (12V, 9Ah)

VI. PERFORMANCE

VII.

A. RPM Generated by system to the Dynamo Shaft

One single push of 60Kg man on system make pinion to rotate at ¾ rotation with linear movement of Rack. This Rotation of main driving shaft will transmitted to another driven shaft which is parallel to the driving shaft by means of chain sprocket mechanism. Rotation of Driven Shaft will be 3 Rotation.
So, the Sun Gear S mounted on the secondary driven shaft will make 3 Rotation. This Sun gear is attached to Planet Gear and planet gear is attached to Dynamo.
So, Speed of Sun Gear $\mathbf{N_s}$ = 3 RPM (approximate)
Number Of teeth on Sun Gear $\mathbf{T_S}$ = 280
Number of teeth on Planet Gear $\mathbf{T_P}$ =16
Now, $\mathbf{N_S T_S = N_P T_P}$
So, $\mathbf{N_P = N_S T_S / T_P}$
Speed of Planet Gear $\mathbf{N_P}$ = 52 RPM
So, Finally Speed of Dynamo shaft N = 52 RPM

B. Spring Calculations :

Helical Spring Used in Our system has following Specification :
Allowable Shear Stress = 385 Mpa
Modulus Of Rigidity (G) = 80 KN/m^2
Modulus Of Elasticity (E) = 210 KN/mm^2
Free Length (LF) = 140 mm
Pitch (P) = 10 mm
Inner Diameter = 20 mm

By using this Footstep Power Generation System, We can generate the 24 Volt. That can be utilized to generate the power in the rural areas as well as places where flow of people is more.

VII. SELECTION OF RACK AND PINION MECHANISM OVER PIEZOELECTRIC POWER GENERATION

Piezoelectric Power generation System is costlier method to generate power. In addition, it generates less power than Footstep Power Generation System.

C. 3D DESIGN OF FRAME OF FOOTSTEP POWER GENERATION SYSTEM

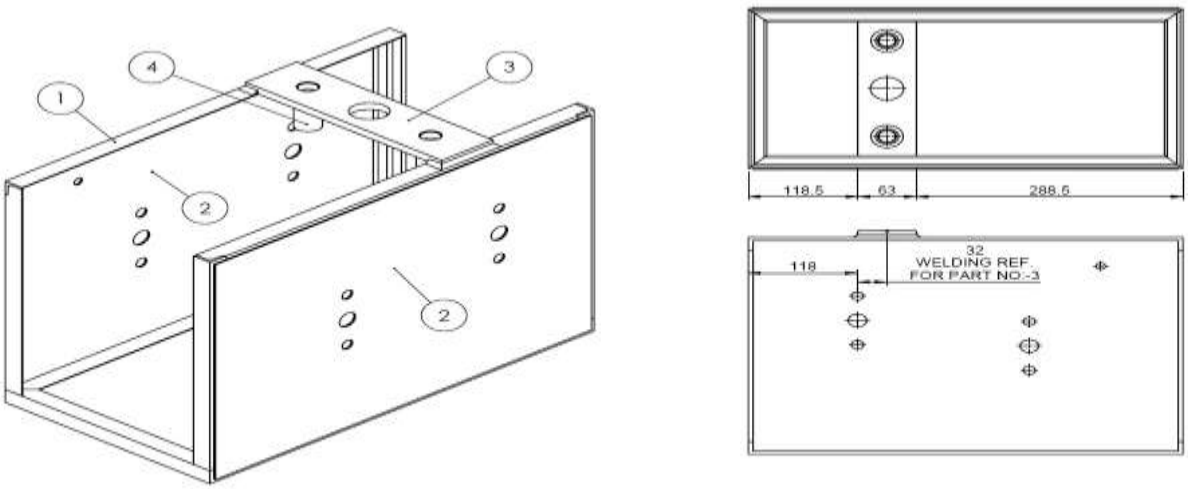

Figure 3. 3D Design of frame of Footstep Power Generation System

IX. 3D DESIGN OF FOOTSTEP POWER GENERATION SYSTEM

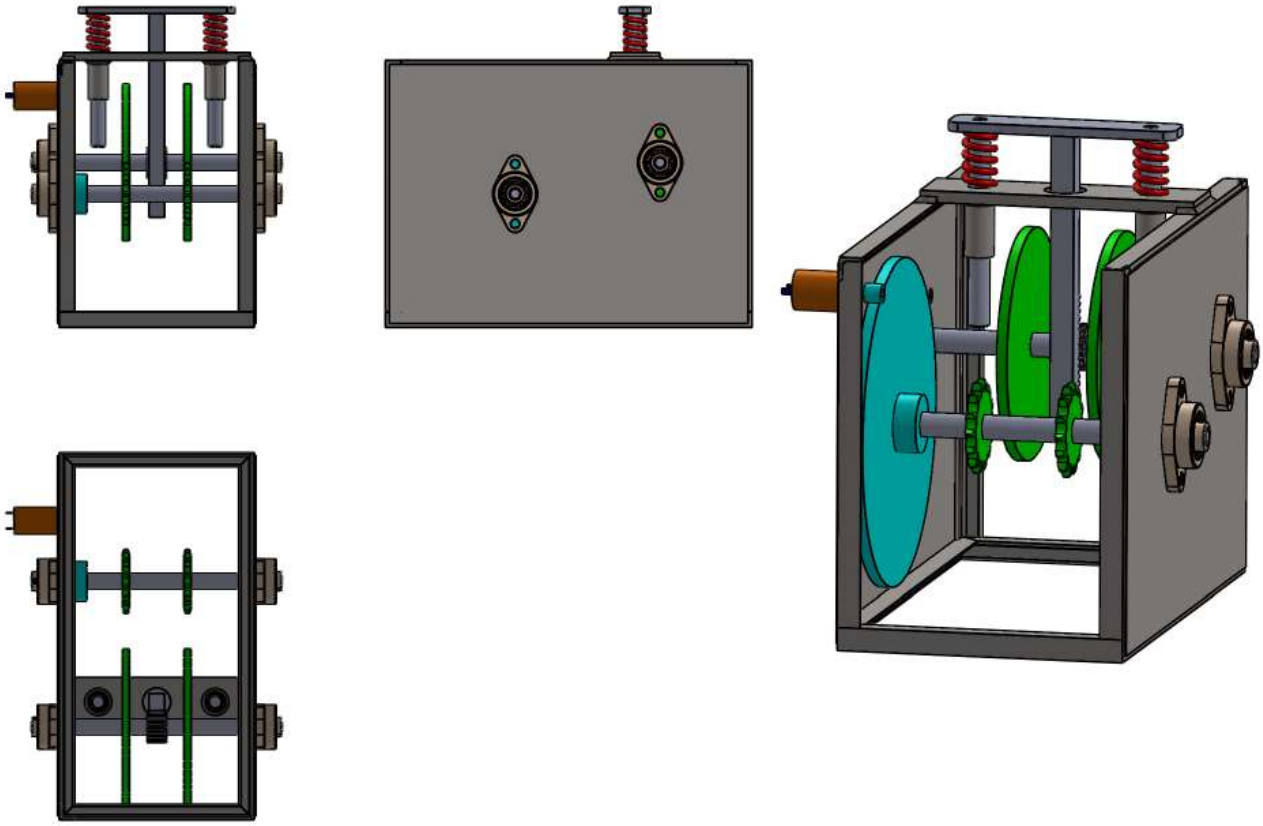

Figure 4. 3D Design of Footstep Power Generation System

X. ADVANTAGES OF FOOTSTEP POWER GENERATION SYSTEM

Power Generation can be using simply walking on the roads.
No requirement of any fuel input.
This is Non conventional System.
Generated power can be stored in the battery.
It is Reliable.
It is Economical.
It is Eco friendly.
It can be used in the emergency power failure situations.
Less number of parts required.
The construction is Easy.
It is Self generating device.
It is available in all season.

XI. APPLICATION OF FOOTSTEP POWER GENERATION SYSTEM

Foot step power generation system can be used in most of the places such as agriculture purpose, home appliances and street lighting.
It can be used for Rural applications
It can be used for Railway station
It can be used in Airports, bus stand
It can be used in Temple
It can be used in Colleges
It can be used in Schools
Cinema theatres
Shopping center
Auditoriums, Music halls
It can be used in the security Alarm.

It can be used in LED lights for specific purpose.
It can be used in over bridges.
It can be used at all places where movement of people is more.

XII. CONCLUSION

This type of Power Generation System has Life time of 5 to 7 years so customer can get free electricity up to 5 years.
As it does not use any external power source and traffic will never reduced .this type of system are more reliable, and have more life than any other power source. In this world where there is shortage of electrical power supply, this will be helpful to society. In Future by applying this system, we can make this energy source available for street lights and road services in any season in any environmental condition.

XIII. ABBREVIATION

3D = 3 Dimensional
LED = Laser Emitting Diode

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