



Fabrication of Staircase Power Generation using Rack and Pinion Mechanism

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Abstract: Electrical energy plays a vital role in our day today life. And now it has been seems to be one of the basic needs of the human beings. As, the population keeps on increasing the demand on the electrical energy is also increasing. The resources for the electrical energy generation are also depleting at a faster rate. So now it has been essential to go for an alternative method to generate electricity. This project attempts to show how energy can be tapped and used at a commonly used system, the generation of electricity through the Foot Step mechanism. Generation of electricity through the Foot Step power generator mechanism is one of the most recent power generation concepts. This device converts the kinetic energy of the human foot steps into electric energy by installing foot step power generators at footpaths, it takes the stroke motion of the foot and converts it to the rotary motion by rack and pinion mechanism and it generates the electricity.

Keywords: Foot Step Mechanism, Rack & Pinion, Power Generators, Kinetic Energy.

I INTRODUCTION

Man has needed and used energy at an increasing rate for his sustenance and well-being 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. Subsequently he discovered fire and his energy needs increased as he started to make use of wood and other bio mass to supply the energy needs for cooking as well as for keeping himself warm.

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.

II NEED FOR NON-CONVENTIONAL ENERGY

Fuel deposit in the will soon deplete by the end of 2020 Fuel scarcity will be maximum. Country like India may not have the chance to use petroleum products. Keeping this dangerous situation in mind we tried to make use of nonpollutant natural resource of petrol energy. 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 inleading to worldwide drought and decertification.

The buzzards of nuclear electric-stations are only to 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. It is not possible to consider such systems and meeting continuous uninterrupted concentrated base load electric power requirements. Energy plays an important role in the material, social and cultural life of mankind. The energy needs are increasing day by day. This is the result of population growth and increase in the standard of living which is directly proportional to energy consumption.

III FOOT STEP ARRANGEMENT

This is made up of mild steel. The complete set up is fixed in this model FOOT STEP. The two L-shapes frame is fixed in the above two ends of the track. Bellow this L-shapes window, the actual power generation arrangement is constructed. This L-shapes window pushes the rack when the time of train wheel moving on these arrangement

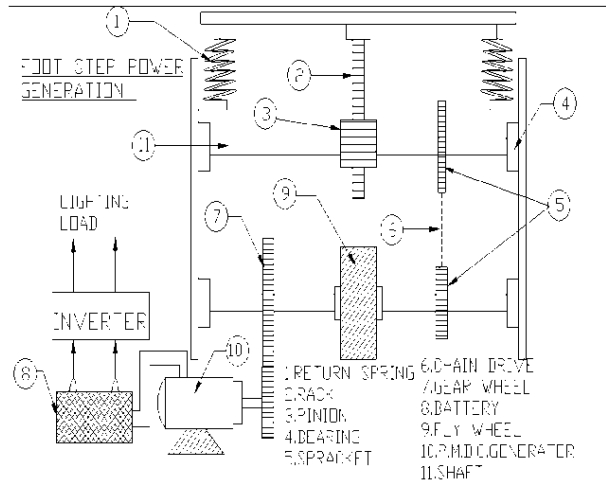


Fig. 1 Assembly Diagram

IV DESIGN AND DRAWINGS

A. DESIGN OF PINION

From PSG design data book (page no.7.18) $d_{min} > (0.59 / \sigma_{cmax}) \times [[Mt] / ((1/E1) + (1/E2))]^{2/3}$ (1)

Where, σ_{cmax} = maximum contact compressive stress N/m²

E1, E2 = Young's modulus N/m²

Mt = Torque N-m

E1 = E2 = 1.1x10⁶ N/m²

Calculation of σ_{cmax}

$\sigma_{cmax} = HB \times CB \times Kcl$ (2)

Where, HB = Brinell hardness number

CB = coefficient depends on hardness

Kcl = life factor

B. SPECIFICATION OF PINION

- Material: Cast-iron
- Outside diameter: 75mm
- Circular pitch: 4.7mm
- Tooth depth: 3.375mm
- Module: 1.5mm
- Pressure angle: 21°
- Pitch circle diameter: 72mm
- Addendum: 1.5mm
- Dedendum: 1.875mm
- Circular tooth Thickness: 2.355mm
- Fillet radius: 0.45mm
- Clearance: 0.375mm

C. DESIGN OF RACK

Pitch circle diameter of the gear is = 72mm Circumference of the gear is = $\pi \times$ pitch circle diameter = $\pi \times 72 = 226$ mm

The dimension is for 360° rotations

For 180° rotations the rack length is 113 mm

D. SPECIFICATION OF RACK

- Material: cast iron
- Module: 1.5mm
- Cross-section: 75x25mm
- Teeth on the rack is adjusted for 113mm



V WORKING PRINCIPLE

The complete diagram of the power generation using FOOT STEP is given below. L-shapes window 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. The rack & pinion, spring arrangement is fixed at the FOOT STEP which is mounded bellow the L-shapes window. The spring is used to return the inclined L-shapes window in same position by releasing the load. The pinion shaft is connected to the supporter by end bearings as shown in fig. The larger sprocket also coupled with the pinion shaft, so that it is running the same speed of pinion. The larger sprocket is coupled to the small cycle sprocket with the help of chain (cycle). This larger sprocket is used to transfer the rotation force to the smaller sprocket. The smaller sprocket is running same direction for the forward and reverse direction of rotational movement of the larger sprocket. This action locks like a cycle pedalling action. The fly wheel and gear wheel is also coupled to the smaller sprocket shaft. The flywheel is used to increase the rpm of the smaller sprocket shaft. The gear wheel is coupled to the generator shaft with the help of another gear wheel. The generator is used here, is permanent magnet D.C generator. The generated voltage is 12Volt D.C. This D.C voltage is stored to the Lead-acid 12 Volt battery. The battery is connected to the inverter. This inverter is used to convert the 12 Volt D.C to the 230 Volt A.C. This working principle is already explained the above chapter. This 230 Volt A.C voltage is used to activate the light, fan and etc. By increasing the capacity of battery and inverter circuit, the power rating is increased. This arrangement is fitted in FOOT STEPS; the complete arrangement is kept inside the floor level except the pushing arrangement.



Fig. 2 Fabricated Model

VI CONCLUSION

In concluding the words of our project, since the power generation using foot step get its energy requirements from the Non-renewable source of energy. There is no need of power from the mains and there is less pollution in this source of energy. It is very useful to the places all roads and as well as all kind of foot step which is used to generate the non-conventional energy like electricity. It is able to extend this project by using same arrangement and construct in the footsteps/speed breaker so that increase the power production rate by fixing school and colleges, highways etc.

REFERENCES

- [1] Rai. G.D. "Non-Conventional Energy Sources", Khanna Publishers, Delhi.
- [2] Ramesh. R, Udaya Kumar, K. Anandkrishnan "Renewable Energy Technologies", Narosa Publishing House, Madras.
- [3] A. K. Sawhney. "A Text Book Of Electrical, Electronics, Instrumentation And Measurements"
- [4] B. L. Therja, A. K. Theraja. "A Text Book Of Electrical Technology"
- [5] G. R. Nagpal. "Power Plant Engineering" Khanna Publishers, Delhi
- [6] T. Nejat Veziroygal , Alternative Energy Sources-Iii, Hemisphere Publishing Co., Barbara Keiler, Energy Alternatives, Lusentr Books.
- [7] Prabhu T.J. Fundamentals Of Machines Design,2009 Design Data, Psg College Of Technology,2007 Bhandari V.B. "Design Of Machine Elements"- Tata Mcgraw Hill,2007
- [8] Shigley J. E. And Misheka "Mechanical Engineering Design" Mcgraw Hill, 2007
- [9] Pandya And Shah "Elements Of Machines Design ", 2000 Maitra, Handbook Of Gear Design, Tata Mcgraw Hill,1995
- [10] Gere Timoshenko "Mechanics of Materials" Cbs, 1997.

BIOGRAPHY

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