

Power Generation Using Foot Step

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ABSTRACT

In this project we are generating electrical power as non-conventional method by simply running on the train in the foot step. Non-conventional energy system is very essential at this time to our nation. Non-conventional energy using foot step needs no fuel input power to generate the output of the electrical power. This project using simple drive mechanism such as rack and pinion assemble and chain drive mechanism.

For this project the conversion of the force energy in to electrical energy. The control mechanism carries the rack & pinion, D.C generator, battery and inverter control. We have discussed the various applications and further extension also. So this project is implemented to all foot step, the power generation is very high. The initial cost of this arrangement is high.

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.

NEED FOR NON-CONVENTIONAL ENERGY

Fuel deposit in the will soon deplete by the end of 2020Fuel 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 non-pollutant 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 man kind. 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.

As we know that mankind will be never lacking in energy. Today, it is liquid fuel, tomorrow it may be uranium with an element of risk. Risk exists where ever there is human activity and production of energy. Just as the supply of fossil fuel is finite thus there will be the supply of uranium. Perhaps, uranium would be exhausted quickly if it is used on a large scale.

It is therefore, harnessing the gigantic inexhaustible solar energy source reduces the dependence on fossil fuels. For the environmental concerned, the solar energy harnessing system offers advantages in that, it emits no pollutants in to the atmosphere as they are with the combustion of fossil fuels. Thus, as a long term option solar energy system can be considered as an alternate to all the finite fuel system. Therefore, there is no energy shortage today nor will there be in the near future.

The lifting of water for drinking or irrigation purposes is of great importance in widely distributed villages with little or no rural electrification and where underground water is available. Solar energy is converted to mechanical energy to drive small water pumps it would be of great help to the rural inhabitants.

In our project we use solar photo voltaic cells for pumping water. The photo voltaic modules convert sunlight direct to electricity which is used to run a dc motor pump for bailing of water. It consists of solar photo voltaic modules, power conditioner to protect storage batteries from over charging during non-sun shine and a dc water pump.

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. Below 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.

BLOCK DIAGRAM

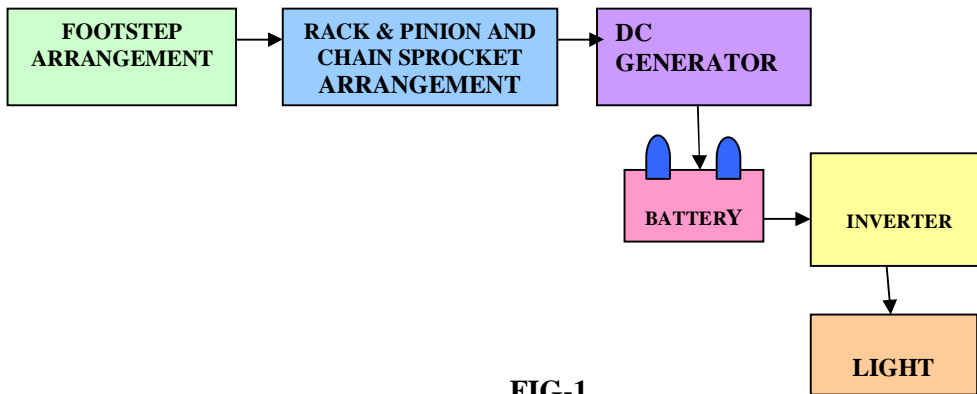


FIG-1

DESIGN AND DRAWINGS

3.1 DESIGN OF PINION

From PSG design data book (page no.7.18)

$$d_{min} > (0.59 / \sigma_{cmax}) \times \left[[Mt] / ((1/E1) + (1/E2))^2 \right]^{1/3} \longrightarrow (1)$$

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}

$$\sigma_{cmax} = H_B \times C_B \times Kcl \longrightarrow (2)$$

Where,

H_B = Brinell hardness number

C_B = coefficient depends on hardness

K_{cl} = life factor

$$K_{cl} = \{[1 \times 10^7]/N\}^{1/6} \quad (3) \longrightarrow$$

$$N = 60 \times n \times T$$

Where

n = rpm

N = life in no. Of cycles

T = life in hours.

= 8000 hours.

From P.S.G design data book (page no.2.4),

$$C_B = 20$$

$$H_B = 200$$

Substituting the values of N , n , T in the equation [3],

The value of k_{cl} is obtained as 1.139.

$$K_{cl} = 1.139.$$

Substituting the values in equation [2]

$$\sigma_{cmax} = 20 \times 200 \times 1.1309$$

$$= 4520 \times 10^5 \text{N/m}^2$$

Calculation of Mt

$$Mt = 97420 \times (Kw/n). \quad (4) \longrightarrow$$

For power calculation

$$\text{Centrifugal force, } f_c = m \omega^2 r \quad \longrightarrow (5)$$

$$M = 7\text{kg}$$

$$W = m \times g$$

$$\omega = 2\pi n/60$$

$$R = 1\text{m}$$

Substituting the values of m , ω , r in equation [4]

$$f_c = 7.56 \text{ N.}$$

$$\text{Downward force, } f_d = m \times g$$

$$\begin{aligned} &= 7 \times 9.81 \\ &= 68.6\text{N}. \\ \text{Centrifugal force, } f &= f_c + f_d \\ &= 68.6 + 7.56 \\ &= 76.17\text{N} \\ \text{Torque} &= f \times r \\ &= 76.17 \times 1 \\ &= 76.2\text{Nm}. \\ \text{Power} &= \text{Torque} \times \text{angular velocity}. \\ &= 76.2 \times 1.05 \\ &= 79.7 \end{aligned}$$

Substituting the value of k_w and n in equation in [3],

$$\begin{aligned} M_t &= 776.7 \\ [M_t] &= 1.4 \times M_t \\ &= 1.4 \times 776.7 \\ &= 1087.1 \text{ N-m} \end{aligned}$$

Substituting the values of σ_{cmax} , $[M_t]$, E_1, E_2 in equation [1],

The minimum diameter of the pinion is calculated to be 78.7mm.

We have taken the standard diameter of pinion as 75mm.

3.1.1 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

3.2 DESIGN OF RACK

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

The dimension is for 360° rotations

For 180° rotations the rack length is 113 mm

3.2.1 SPECIFICATION OF RACK

Material : cast iron
Module : 1.5mm
Cross-section : 75×25mm
Teeth on the rack is adjusted for 113mm

3.3 OUTPUT POWER CALCULATION

Let us consider,

The mass of a body = 60 Kg (Approximately)
Height of speed brake = 10 cm

∴ Work done = Force x Distance

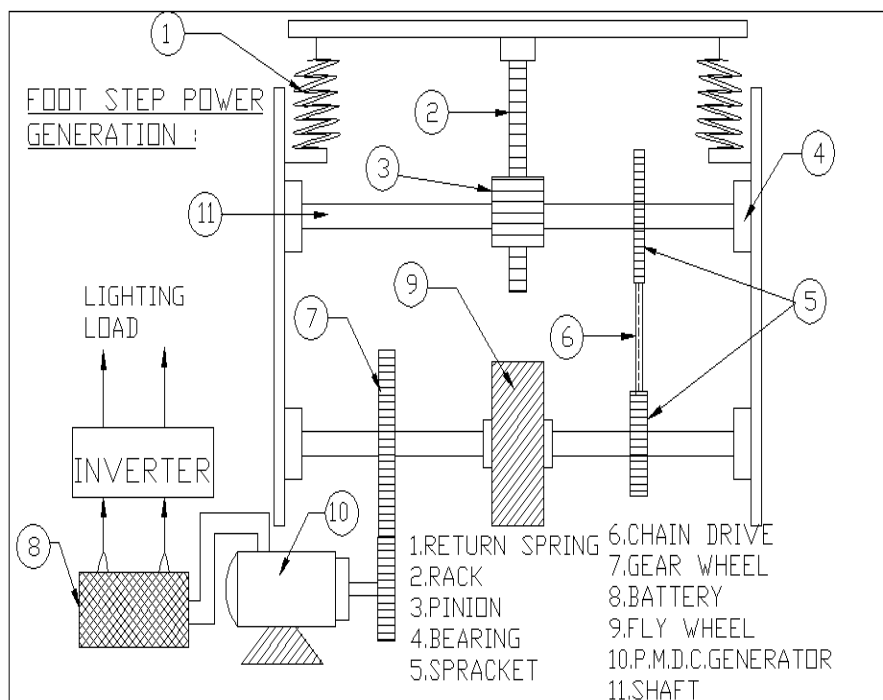
Here,

Force = Weight of the Body
= 60 Kg x 9.81
= 588.6 N
Distance traveled by the body = Height of the speed brake
= 10 cm

$$\begin{aligned}
 &= 0.10 \text{ m} \\
 \therefore \text{Output power} &= \text{Work done/Sec} \\
 &= (588.6 \times 0.10)/60 \\
 &= 0.98 \text{ Watts} \\
 &\text{(For One pushing force)}
 \end{aligned}$$

However, this much power produced, it cannot be tapped fully. From the above purpose we have select to generate electricity by permanent magnet type D.C generator and store it by 12V lead-acid battery cell.

ASSEMBLY DIAGRAM



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 pedaling 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.

FABRICATED MODEL



FIG-27

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 foot steps/speed breaker so that increase the power production rate by fixing school and colleges, highways etc.

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