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Design & Manufacturing of Power Generation by Using Gear Mechanism

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Abstract: *In this project we are generating electrical power as a 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 footsteps needs no fuel input power to generate the output of the electrical power. This project uses simple drive mechanisms such as rock and pinion assemble and chain drive mechanism. For this project the conversion of the force energy into electrical energy. The control mechanism carries the rack & pinion, D.C generator, battery. We have discussed the various applications and further extension also. So, this project is implemented at all steps, the power generation is very high. The initial cost of this arrangement is high.*

Keywords: CAD, Principal, Power Transition, Calculation, etc.

I. INTRODUCTION

For an alternate method to generate electricity there are number of methods by which electricity can be produced, out if such methods footstep energy generation can be an effective method to generate electricity. Walking is the most common activity in human 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 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. This device, if embedded in the footpath, can convert foot impact energy into electrical form.

1.1 Basic Principle

Electrical power as non-traditional strategy by essentially strolling or running on the stride. On- conventional system is very essential at this time to our nation. Non-ordinary vitality utilizing stride is changing over mechanical vitality into the electrical vitality. There is some method to generate electrical energy from footsteps. Such as gear wheel and flywheel are methods to generate electrical power. This method works on the movement of gear rack or pinion and its mechanical parts are used because this is placed where there are so many people and the energy is produced by their movement on the floor.

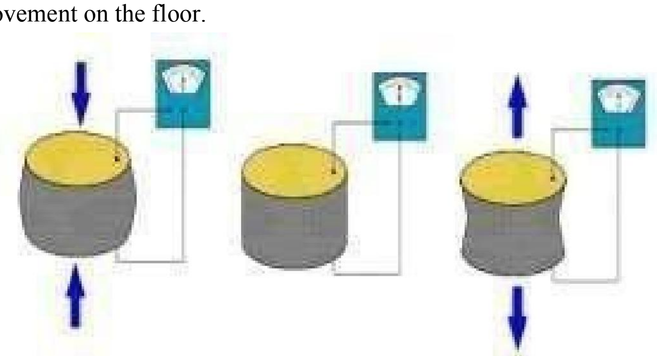

Figure 1.2: Basic Principle

II. LITERATURE SURVEY

"Power Generation from Piezoelectric Footstep Technique" By Muhammad Aamir Aman, Hamza Umar Afridi, Muhammad Zoolagnia Abbasi

The formation of electrical energy from the force exerted by footstep on the floor is illustrated in this research work. It will be surprising to know that the normal footstep movement on the floor can generate how much energy. As thousands of steps per day is taken by each person. Electrical energy is generated by the footstep taken by the peoples as a result of walking. It is a fact that large amount of energy is lost by each person during routine walk which is the main source for this system. The approach of this Electro-Kinetic energy floor is to convert kinetic energy into electrical energy by walking on floor. The energy that is produced from a person walking on floor is noise and pollution free. That type of energy is advantageous and even not need any type of fuel or power source to run. By implementation of this renewable energy in today's world while the demand of energy is increasing day by day is the current solution of this modern world. In this research work a system is designed which generate power through non-conventional energy source technique such a walking on the gardens, grounds, and floors etc. This system is established in heavy populated areas.

"Electrical Power Generation Using Footsteps" By Iqbal Mahmud

This paper focuses on designing a setup that leads to the generation of electrical energy which is going to waste when humans are walking. Footsteps are an untapped-natural resources. This generated energy is, however, cost effective and nonhazardous for human. Electrical energy can be produced by converting mechanical energy using footsteps. Generating the electric power through the fabrication of footstep arrangement by a prototype comprises of a pipe, nozzle, unidirectional valve, water reservoir, turbine, and DC motor. Whenever pressure is exerted on the reservoir, water flows through the nozzle into the turbine and generates electrical energy. This energy is stored in the battery.

III. DESIGN AND ANALYSIS

1) CAD [Computer Aided Designing]

Computer-aided design (CAD) is the use of computer system (or workstation) to aid in the creation, modification, analysis, or optimization of a design. CAD software is used to increase the productivity of the designer, improve the quality of design, improve communications through documentation, and to create a database for manufacturing. CAD output is often in the form of electronic files for print, machining, other manufacturing operations. The term CADD (for Computer Aided Design and Drafting) is also used. Its use in designing electronic systems is known as electronic design automation (EDA). In mechanical design it is known as mechanical design (MDA) or computer-aided drafting (CAD), which includes the process of creating a technical drawing with the use of computer software.

CAD software for mechanical design uses either vector-based graphics to depict the objects of traditional drafting, or may also produce raster graphics showing the overall appearance of designed objects. However, it involves more than just shapes. As in the manual drafting of technical and engineering-drawing the output of convey information, such as materials, processes, dimensions, and tolerances, according to application-specific conventions. CAD may be used to design curves and figures in two- dimensional (2D) space; or curves, surfaces, and solids in three-dimensional (3D) space. CAD is an important industrial art used in many applications, including automotive, shipbuilding, and aerospace industries, industrial and architectural design, prosthetics, and many more. CAD is also widely used to produce computer animation for special effects in movies, advertising and technical manuals, often called DCC digital content creation.

The modern ubiquity and power of computers means that even perfume bottles and shampoo dispensers are designed using techniques unheard of by engineers of the 1960s. Because of its enormous economic importance, CAD has been a major driving force for research in computational geometry, computer graphics (both hardware and software), and discrete differential geometry.

The design of geometric models for object shapes, in particular, is occasionally called computer-aided geometric design (CAGD).

2) Uses

Computer-aided design is one of the many tools used by engineers and designers and is used in many ways depending on the profession of the user and the type of software in question. CAD is one part of the whole Digital Product Development (DPD) activity within the Product lifecycle management (PLM) processes, and as such is used together with other tools, which are either integrated modules or stand-alone products, such as:

1. Computer aided engineering (CAE) and Finite element analysis (FEA).
2. Computer aided Manufacturing (CAM) including instructions to Computer numerical control {CNC} machines.
3. Photorealistic rendering and Motion Simulation.
4. Document management and revision control using Product data management (PDM).

CAD is also used for the accurate creation of photo simulations that are often required in the preparation of Environmental Impact Reports, in which computer-aided designs of intended buildings are superimposed into photographs of existing environments to represent what that locale will be like, where the proposed facilities are allowed to be built. Potential blockage of view corridors and shadow studies are also frequently through the use of CAD. CAD has been proven to be useful to engineers as well. Using four properties which are history, features, parameterization, and high-level constraints.
The construction history can be used to look back into the model's personal features and work on the single area rather than the whole model. Parameters and constraints can be used to determine the size, shape, and other properties of the different modelling elements. The features in the CAD system can be used for the variety of tools for measurement such as tensile strength, yield strength, electrical or electromagnetic properties. Also, its stress, strain, timing or how the element gets affected in certain temperatures, etc.

3) Types

There are several different types of CAD, each requiring the operator to think differently about how to use them and design their virtual components in a different manner for each. There are many producers of the lower-end 2D systems, including a number of free and open-source programs.
3D wireframe is basically an extension of 2D drafting (not often used today). Each line has to be manually inserted into the drawing. The final product has no mass properties associated with it and cannot have features directly added to it, such as holes. 3D "dumb" solids are created in a way analogous to manipulations of real-world objects (not often used today). Basic three-dimensional geometric forms (prisms, cylinders, spheres, and so on) have solid volumes added or subtracted from them as if assembling or cutting real-world objects. Two-dimensional projected views can easily be generated from the models. There are two types of 3D solid modelling

1. Parametric modelling allows the operator to use what is referred to as "design intent". The objects and features created are modifiable. Any future modifications can be made by changing how the original part was created. If a feature was intended to be located from the centre the part, the operator should locate it from the centre of the model. The feature could be located using any geometric object already available in the part, but this random placement would defeat the design intent.
2. Direct or Explicit modeling provide the ability to edit geometry without a history tree. With direct modelling, once a sketch is used to create geometry the sketch is incorporated into the new geometry and the designer just modifies the geometry without needing the original.

Top end systems offer the capabilities to incorporate more organic, aesthetics and ergonomic features into designs. Free from surface modelling is often combined with solids to allow the designer to create products that fit the human form and visual requirements as well as they interface with the machine.

IV. BASIC CALCULATION

1) Rack and Pinion Design

Its design procedure is same as spur gear procedure

Let consider 30 Kg load is to be lifted by the bench-press.So, F= 30 X 9.81 = 300N

So, the torque transmitted to pinion is given asT =F * r

= 300* 0.035

= 10.5 Nm P

= 2ΠNT/ 60

= 2*3.14*10.5*30 /60

= 0.44W

Now, we consider gear ratio as $G = d_p / d_g = N_g / N_p = Z_p / Z_g$

Here rack is acting as gear and pinion. Gearratio is 1

Because, $N_g = 30$; $N_p = 30$

2) Power transmitted = 0.44 W

3) C.I material for gear and pinion

For pinion (S_{ut} = 260 N/mm^2) Forgear (S_{ut} =260 N/mm^2 }

4) Factor of Safety [FOS] = 1

5) Considering 20^0 full depth involute system8m<b<12m

Minimum $Z_p = 17$ for $\beta = 20^0$ $Z_g = 1 * Z_p$

$Z_p = Z_g = 17$ .... practically

6) Beam Strength

$\sigma_{bp} = \sigma_{bg} = (S_{ut})_p / 3 = 260 / 3 = 86.66$ N/mm^{2}lewisform factor,

$Y_g = Y_p = 0.484 - 2.87/Z_p = 0.484 - 2.87/17 = 0.315$

So, $(\sigma_{bg} * Y_g) = (\sigma_{bp} * Y_p) = (86.66 * 0.315) = 27.297$ N/mm^2$F_b = (\sigma_b)_p$ $* Y_p * m b$

= 27.297*10m*m

= 272.97 m^2

7) Wear Strength

Wear strength is calculated as$d_p = m Z_p = 17m$

$Q = 2 Z_g / Z_g + Z_p$

= (2*17) / 34

= 1

K = 0.16 [BHN / 100]^2

= O.16 [197 / 100]^2

= 0.620

8) Shaft Calculation

We select M.S material for shaft, ϱ = 7860 kg/ m^3

L = 0.382 m (we consider this length for given value of oil tank)
M_t = torsional moment (torque) acting on the shaft i.e., torque supplied to shaft from motor M_t = 10.5 Nm
G = Modulus of rigidity (N/ m^2) for M.S. materialG = 79300 N/ m^2 = 79300 * 10^6 N/ m^2 For line shaft $\Theta = 3^0$ per meter length. Design date book, table no. 9.8, V.B. Bhandari

Now we know that, $\Theta = (584 * M_t * l)/ (G * d^4)$
$d^4 = (584 * 10.5 * 0.382)/ 79300 * 10^6 * 3^0$
$d^4 = 12.55 * 10^{-3}$
Hence d = 12.55 mm

From Design date book, table no. 9.3, V.B. Bhandari we select std. Dimension of shaft. d= 14 mm & designation of shaft as ISRO 14

Design of Main Spring
Outer diameter of the spring D0= 48mm
As per design data book for cold drawn wire steel wire diameter d = 6 mm, Inner diameter of spring,
Di = 48-12 = 36 mm
Calculating the load bearing capacity of spring for any service life, Spring index C= Do/d = 48/6 =8
C = 8
Then Wahl factor of spring, K= (4C-1)/(4C-4)
+ 0.615/C
For C =8
K= 1.18
Now to Find load holding by spring P, P = 618:47N
Thus, spring hod the load of 708.54 N remaining load is absorbed by magnet. Deflection of spring (δ) can calculate by,
δ = (8PD3N) =(Gd4)
δ = 56:04mm
Spring rate = P= = 11N-mm Spring stiffness = K = 11N-mm:
Number of turns = N = 17
As spring has square and ground ends number of Inactive turns = 2 Total number of turns, N = 17
Free length of spring,
Lf = solid length + deflection + axial gap
= 55 + 56 + 0.15(56)
= 55 + 56 + 0.15(56)
Lf = 120mm, Pitch of spring = Lf=N

V. CONCLUSION AND DISCUSSION

We have successfully designed this project for that purpose, we have used the CATIA V5 R20 software. As total deformation and directional deformation (invertical direction) is very minimal, the design for Electricity Generation Footstep (Rack and pinion) for Power Generation Unit is safe and generating up to 3-4 volts of energy.

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