

ELECTRICAL POWER GENERATION USING FOOT STEPS

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Abstract—

The objective of this paper is to generate the electric power through the fabrication of foot step arrangement. Now day's power demand is increased, so this paper is used to generate the electrical power in order to compensate the electric power demand. This paper is designed with foot step arrangement, Dynamo, Rectifier with filter and battery. Foot step arrangement is the mechanical arrangement with wheels. This arrangement is placed in the crowded area side.

1. INTRODUCTION

Energy is the ability to do work. While energy surrounds us in all aspects of life, the ability to harness it and use it for constructive ends as economically as possible is the challenge before mankind. Alternative energy refers to energy sources which are not based on the burning of fossil fuels or the splitting of atoms. The renewed interest in this field of study comes from the undesirable effects of pollution (as witnessed today) both from burning fossil fuels and from nuclear waste byproducts. Fortunately there are many means of harnessing energy which have less damaging impacts on our environment.

The alternatives are solar energy, Wind Power Geothermal, Tides and Hydroelectric. In addition to these we have developed a new methodology of generating power using human energy and the name of this alternative is a foot step power generation.

a) LITERATURE SURVEY

The usage of traditional power generation method such as burning of coal, wood, diesel (generators) etc is continuously depleting our natural resources such as fossil fuels, which is the demand for power has exceed the supply due to the rising population. In addition to this the traditional methods cause pollution, encourage deforestation (cutting of trees) the consequences are global warming, power shortage like we are facing in tamilnadu.

b) GLOBAL WARMING

Global warming is the increase in the average measured temperature of the Earth's near-surface air and oceans since the mid-20th century, and its projected

continuation. Global surface temperature increased 0.74 ± 0.18 °C (1.33 ± 0.32 °F) during the 100 years ending in 2005. The Intergovernmental Panel on Climate Change (IPCC) concludes that most of the increase since the mid-twentieth century is "very likely" due to the increase in anthropogenic greenhouse gas concentrations. Natural phenomena such as solar variation combined with volcanoes probably had a small warming effect from pre-industrial times to 1950 and a small cooling effect from 1950 onward.

Climate model projections summarized by the IPCC indicate that average global surface temperature will likely rise a further 1.1 to 6.4 °C (2.0 to 11.5 °F) during the twenty-first century. This range of values results from the use of differing scenarios of future greenhouse gas emissions as well as models with differing climate sensitivity. Although most studies focus on the period up to 2100, warming and sea level rise are expected to continue for more than a thousand years even if greenhouse gas levels are stabilized. The delay in reaching equilibrium is a result of the large heat capacity of the oceans.

Increasing global temperature is expected to cause sea levels to rise, an increase in the intensity of extreme weather events, and significant changes to the amount and pattern of precipitation, likely including an expanse of the subtropical desert regions.. Other expected effects of global warming include changes in agricultural yields, modifications of trade routes, glacier retreat, mass species extinctions and increases in the ranges of disease vectors.

Remaining scientific uncertainties include the amount of warming expected in the future, and how warming and related changes will vary from region to region around the globe. Most national governments have signed and ratified the Kyoto Protocol aimed at reducing greenhouse gas emissions, but there is ongoing political and public debate worldwide regarding what, if any, action should be taken to reduce or reverse future warming or to adapt to its expected consequences.

Global dimming, the gradual reduction in the amount of global direct irradiance at the Earth's surface, may have partially mitigated global warming in the late 20th century. From 1960 to 1990 human-caused aerosols likely precipitated this effect. Scientists have stated with 66–90% confidence that the effects of human-caused aerosols, along with volcanic activity, have offset some of the global warming, and that greenhouse gases would have resulted in more warming than observed if not for these dimming agents.

Ozone depletion, the steady decline in the total amount of ozone in Earth's stratosphere, is frequently cited in relation to global warming. Although there are areas of linkage, the relationship between the two is not strong.

c) POWER SHORTAGE

Some developing countries and newly-industrialized countries have several hours of daily power-cuts in almost all cities and villages because the increase in demand for electricity exceeds the increase in electric power generation. Wealthier people in these countries may use a power-inverter (rechargeable batteries) or a diesel/petrol-run electric generator at their homes during the power-cut. The use of standby generators is common in industrial and IT hubs.

d) ULTIMATE AIM

The ultimate aim of this project is to develop much cleaner cost effective way of power generation method, which in turns helps to bring down the global warming as well as reduce the power shortages.

2. DESCRIPTIONS

a) RACK AND PINION

The rack and pinion is used to convert between rotary and linear motion. The rack is the flat, toothed part, the pinion is the gear. Rack and pinion can convert from rotary to linear or from linear to rotary. The diameter of the gear determines the speed that the rack moves as the pinion turns. Rack and pinions are commonly used in the steering system of cars to convert the rotary motion of the steering wheel to the side to side motion in the wheels. Rack and pinion gears give a positive motion especially compared to the friction drive of a wheel in tarmac. In the rack and pinion railway a central rack between the two rails engages with a pinion on the engine allowing the train to be pulled up very steep slopes. A rack is a toothed bar or rod that can be thought of as a sector gear with an infinitely large radius of curvature.

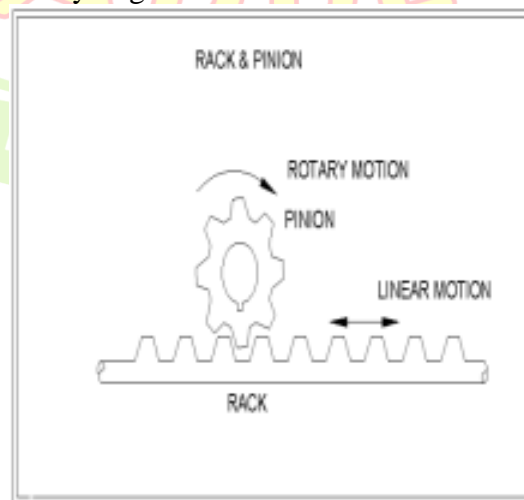


Fig.1

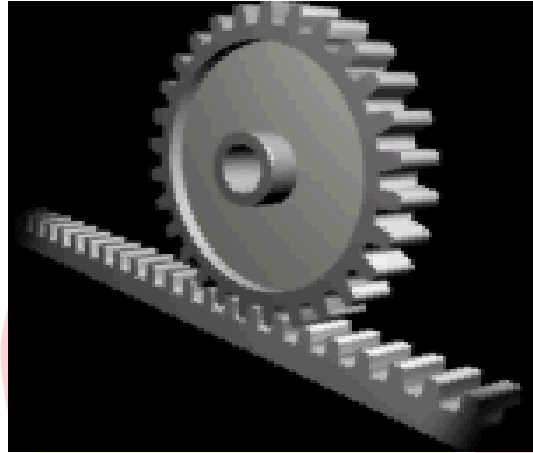


Fig.2

Torque can be converted to linear force by meshing a rack with a pinion: the pinion turns; the rack moves in a straight line. Such a mechanism is used in automobiles to convert the rotation of the steering wheel into the left-to-right motion of the tie rod(s). Racks also feature in the theory of gear geometry, where, for instance, the tooth shape of an interchangeable set of gears may be specified for the rack (infinite radius), and the tooth shapes for gears of particular actual radii then derived from that. The rack and pinion gear type is employed in a rack railway.

b) DYNAMO

Dynamo is an electrical generator. This dynamo produces direct current with the use of a commutator. Dynamo were the first generator capable of the power industries. The dynamo uses rotating coils of wire and magnetic fields to convert mechanical rotation into a pulsing direct electric current. A dynamo machine consists of a stationary structure, called the stator, which provides a constant magnetic field, and a set of rotating windings called the armature which turn within that field. On small machines the constant magnetic field may be provided by one or more permanent magnets; larger machines have the constant magnetic field provided by one or more electromagnets, which are usually called field coils. The commutator was needed to produce direct current. When a loop of wire rotates in a magnetic field, the potential induced in it

reverses with each half turn, generating an alternating current.

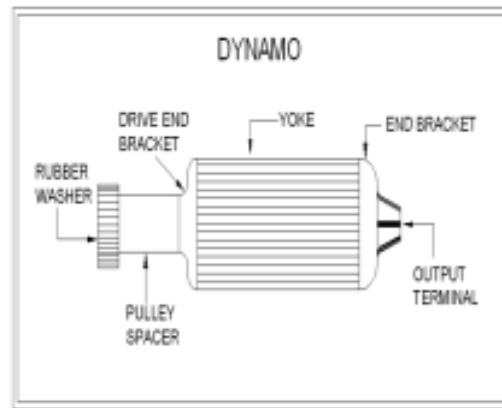


Fig.3

However, in the early days of electric experimentation, alternating current generally had no known use. The few uses for electricity, such as electroplating, used direct current provided by messy liquid batteries. Dynamos were invented as a replacement for batteries. The commutator is a set of contacts mounted on the machine's shaft, which reverses the connection of the windings to the external circuit when the potential reverses, so instead of alternating current, a pulsing direct current is produced.

c) RECTIFIER

Rectifier is an electrical device .it is converting to the alternating current to direct current this process known as rectification. Rectifier has many uses it can be found in many power supply components and also as a detector. The term rectifier describes a diode that is being used to convert AC to DC. Almost all rectifiers comprise a number of diodes in a specific arrangement for more efficiently converting AC to DC than is possible with only one diode.

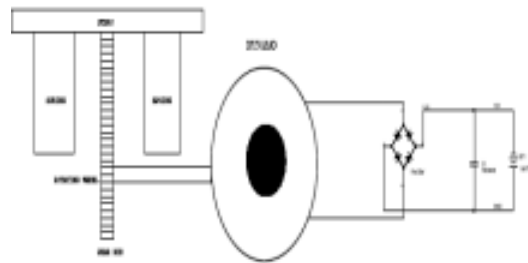


Fig.4

d) FILTER

Electronic filters are electronic circuits which perform signal processing functions, specifically intended to remove unwanted signal components and/or enhance wanted ones.

e) BATTERY

In our project we are using secondary type battery. It is rechargeable type. A battery is one or more electrochemical cells, which store chemical energy and make it available as electric current. There are two types of batteries, primary (disposable) and secondary (rechargeable), both of which convert chemical energy to electrical energy. Primary batteries can only be used once because they use up their chemicals in an irreversible reaction. Secondary batteries can be recharged because the chemical reactions they use are reversible; they are recharged by running a charging current through the battery, but in the opposite direction of the discharge current. Secondary, also called rechargeable batteries can be charged and discharged many times before wearing out. After wearing out some batteries can be recycled.

Batteries have gained popularity as they became portable and useful for many purposes. The use of batteries has created many environmental concerns, such as toxic metal pollution. A battery is a device that converts chemical energy directly to electrical energy it consists of one or more voltaic cells. Each voltaic cell consists of two half cells connected in series by a conductive electrolyte.

One half-cell is the positive electrode, and the other is the negative electrode. The electrodes do not touch each other but are electrically connected by the electrolyte, which can be either solid or liquid. A battery can be simply modeled as a perfect voltage source which has its own resistance, the resulting voltage across the load depends on the ratio of the battery's internal resistance to the resistance of the load. When the battery is fresh, its internal resistance is low, so the voltage across the load is almost equal to that of the battery's internal voltage source. As the battery runs down and its internal resistance increases, the voltage drop across its internal resistance increases, so the voltage at its terminals decreases, and the battery's ability to deliver power to the load decreases.

Battery is used for storing the energy produced from the solar power. The battery used is a lead-acid type and has a capacity of 12V; 2.5A. The most inexpensive secondary cell is the lead acid cell and is widely used for commercial purposes. A lead acid cell when ready for use contains two plates immersed in a dilute sulphuric acid (H_2SO_4) of specific gravity about 1.28. The positive plate (anode) is of Lead peroxide (PbO_2) which has a chocolate brown color and the negative plate (cathode) is lead (Pb) which is of grey color. When the cell supplies current to a load (discharging), the chemical action that takes place forms lead sulphate ($PbSO_4$) on both the plates with water being formed in the electrolyte. After a certain amount of energy has been withdrawn from the cell, both plates are transformed into the same material and the specific gravity of the electrolyte (H_2SO_4) is lowered. The cell is then said to be discharged. There are several methods to ascertain whether the cell is discharged or not.

To charge the cell, direct current is passed through the cell in the reverse direction to that in which the cell provided current. This reverses the chemical process and again forms a lead peroxide (PbO_2) positive plate and a pure lead (Pb) negative plate. At the same time, (H_2SO_4) is formed at the expense of water, restoring the electrolyte (H_2SO_4) to its original condition. The chemical changes that occur during discharging and recharging of a lead-acid cell.

f) SPRING

A spring is defined as an elastic body, whose function is to distort when loaded and to recover its original shape when the load is removed. The springs used here are open coil helical springs which are used where there is a compression load. These springs are made from oil tempered carbon steel wires containing 0.60 to 0.75% carbon 0.6 to 1% Manganese.

The automobile chassis is mounted on the axles not directly but through some form of springs. This is done to isolate the vehicle body from the road shocks which may be in the form of bounce, pitch, roll or sway. These tendencies give rise to an uncomfortable ride and also cause additional stress in the automobile frame and body. All the parts which perform the function of isolating the automobile from the road shocks are collectively.

A springing device must be a compromise between flexibility and stiffness. If it is more rigid, it will not absorb road shocks efficiently and if it is more flexible it will continue to vibrate even after the bump has passed so we must have sufficient damping of the spring to prevent excessive flexing. A spring is a flexible elastic object used to store mechanical energy. Springs are usually made out of hardened steel. Small springs can be wound from pre-hardened stock, while larger ones. A spring is a mechanical device,

which is typically used to store energy and subsequently release it, to absorb shock, or to maintain a force between contacting surfaces.

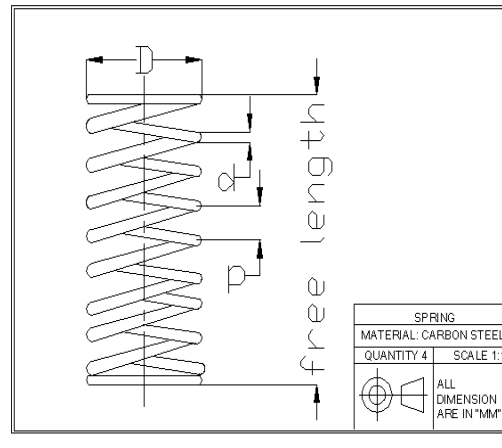


Fig.5

They are made of an elastic material formed into the shape of a helix which returns to its natural length when unloaded this is called return spring. Springs are placed between the road wheels and the vehicle body. When the wheel comes across a bump on the road, it rises and deflects the spring, thereby storing energy therein. On releasing, due to the elasticity of the spring material, it rebounds thereby expending the stored energy. In this way the spring starts vibrating, with amplitude decreasing gradually on internal friction of the spring material and friction of the suspension joints till vibrations die down.

g) V -- BELT DRIVES

A v- belt is mostly used in factories and workshops where a great amount of power is to be transmitted from one pulley to another when the two pulleys are very near to each other. The v-belts are made of fabric and cords molded in rubber and covered with fabric and rubber.

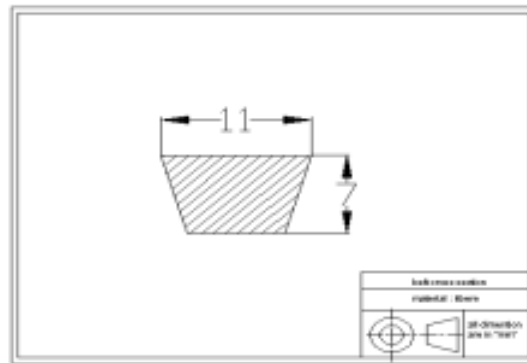


Fig.6

These belts are molded to a trapezoidal shape and are made endless .these are particularly suitable for short drives. The included angle for the v-belt is usually forming 30° to 40° .the power transmitted by the wedging.

h) SPUR GEAR

The slipping belt of a belt is a common phenomenon, in the transmission of motion or power between two shafts. The effect of slipping is to reduce the velocity ratio of the system precision machines, in which a definite velocity ratio is of importance, the only positive drive is by gears or toothed wheels. A gear drive is also provided, when the distance between the driver and the follower is very small.



Fig.7

3. DESIGNING

The foot step power generation machine consists of the following technical data and design calculations to full fill the requirements of complete operations of a machine.

a) DESIGN DATA

Rack

Material: mild steel

Number of teeth =38
Length of rack =180mm

Pinion

Dia meter of pinion =90mm
No of teeth =64 no

Spring

Dia of wire (d) = 2mm
Mean dia of spring (D) =30mm
Number of turns (n) =14no
Free length =115mm

Dynamo

Material of yoke =mild steel

Battery

Voltage =12v dc
Material =plastic
Type =lead acid battery

Spur Gear

No of teeth =96 no
Length of the gear =105mm
Thickness of the gear =10mm

Shaft

Length of the shaft =160mm
Dia of the shaft =16mm

Pulley

Driven pulley Dia (D) =250mm
Arm length =105mm
Driving pulley dia (d) =50mm
Rim thickness =5mm

Belt

Cross section thickness of belt =7mm
Width (b) =11mm
Angle of 'v' belt =50°

b) DESIGN CALCULATION

Power Output

N =100 rpm (assume)

Weight =70kg (average weight of human)

70X10 =700N

Power =force X velocity

$$P = 700 \times 3.14 \times 16 \times 10^{-3} / 60 \times 100$$

$$P = 58.6 \text{ W}$$

P = 60 watts power is to be transmitted

Length of Belt

$$L = 2c + 3.14/2 (D+d) + (D-d)^2 / 4c$$

C center of distance = 225 mm

Speed ratio $I = D/d$

$$I = 250/50$$

$$I = 5$$

The recommended c/D ratio is 0.9

Therefore,
 $c/D = 0.9$, $c/250 = 0.9$, $c = 250 \times 0.9$, $c = 225 \text{ mm}$

$$L = 2c + 3.14/2 (D+d) + (D-d)^2 / 4c$$

$$L = 2 \times 225 + 3.14/2 (250+50) + (250-50)^2 / 4 \times 225$$

$$L = 965.67 \text{ mm}$$

L = 96 cm (length of the belt)

$$\begin{aligned} \text{Angle of contact, } \theta &= 180 - (D-d)/c \times 60^\circ \\ \theta &= 180 - (250-50)/225 \times 60^\circ \\ \theta &= 126.6^\circ \end{aligned}$$

Initial belt tension to be promised for firm grip of the v-belt on pulleys, is 0.5% of L

New length = $L + 0.5\% \times L$

$$\begin{aligned} &= 965 + 0.5\% \times 965 \\ &= 970 \text{ mm} \end{aligned}$$

4. WORKING PRINCIPLE

The complete diagram of the foot step power generation is given below fig.8. Only one step 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 inclined step. The spring is used to return the inclined step 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 complete block diagram is shown in fig.7.

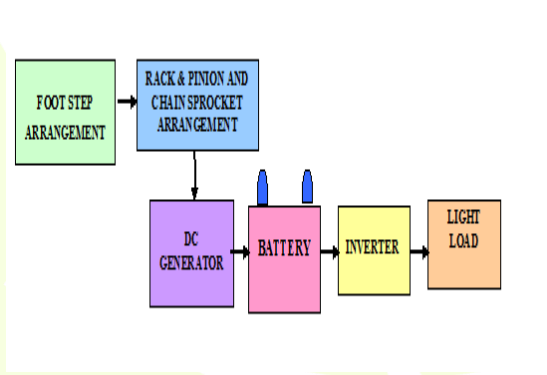


Fig.7

The fly wheel and gear wheel is also coupled to the smaller sprocket shaft. The flywheel is used to increase the rpm .

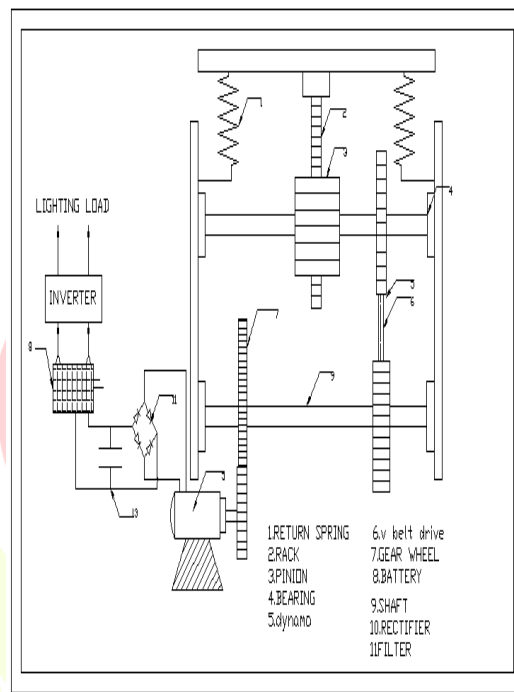


Fig.8

5. CONCLUSION

This paper is made with pre planning, that it provides flexibility in operation. Smoother and noiseless operation by the medium of “FOOT STEP POWER GENERATION”. This paper is designed with the hope that it is very much economical and help full to many industries and workshops.

6. REFERENCES

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