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Generation of Electrical Energy from Foot Step Using Rack and Pinion Mechanism

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Abstract:
Man has needed and used energy at an increasing rate for his sustenance and wellbeing ever since he came on the earth a few million years ago. Due to this a lot of energy resources have been exhausted and wasted. Proposal for the utilization of waste energy of foot power with human locomotion is very much relevant and important for highly populated countries like India and China where the roads, railway stations, bus stands, temples, etc. are all over crowded and millions of people move around the clock.

This whole human/ bio-energy being wasted if can be made possible for utilization it will be great invention and crowd energy farms will be very useful energy sources in crowded countries. In this paperdescribed about generation electrical power as non-conventional method by simply walking or running on the foot step. Non-conventional energy system is very essential at this time to our nation. Non-conventional energy using foot step is converting mechanical energy into the electrical energy. Here in this project a mechanical arrangement is made. That is rack and pinion gear mechanism (chain and sprocket used here)

In this project the conversion of the force energy in to electrical energy. The control mechanism carries the, unidirectional current controller and 12V, 1.3Amp lead acid dc rechargeable battery and an inverter is used to drive AC/DC loads. 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 230 Volt A.C voltage is used to activate the loads. We are using conventional battery charging unit also for giving supply to the circuitry.This project uses regulated 5V power, 500mA power supply. Bridge type full wave rectifier is used to rectify the ac output of secondary of 230/12V step down transformer.

I. INTRODUCTION:

Man has needed and used energy at an increasing rate for his sustenance and wellbeing 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. 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

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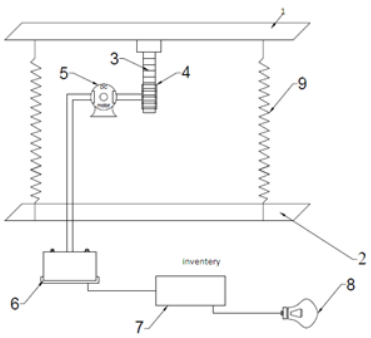
training animals to work for him. With further demand for energy, man began to use the wind for sailing ships and for driving windmills, and the force of falling water to turn water for sailing ships and for driving windmills, and the force of falling water to turn water wheels. Till this time, it would 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.

Existing System:

Other people have developed piezo-electric (mechanical-to-electrical) surfaces in the past, but the Crowd Farm has the potential to redefine urban space by adding a sense of fluidity and encouraging people to activate spaces with their movement. The Crowd Farm floor is composed of standard parts that are easily replicated but it is expensive to produce at this stage. This technology would facilitate the future creation of new urban landscapes athletic fields with a spectator area, music halls, theatres, nightclubs and a large gathering space for rallies, demonstrations and celebrations, railway stations, bus stands, subways, airports etc. Like Capable Of Harnessing Human Locomotion For Electricity Generation.

Proposed System:

Proposal for the utilization of waste energy of foot power with human locomotion is very much relevant and important for highly populated countries like India and China where the roads, railway stations, bus stands, temples, etc. are all over crowded and millions of people move around the clock. This whole human/bioenergy being wasted if can be made possible for utilization it will be great invention and crowd energy farms will be very useful energy sources in crowded countries. Walking across a "Crowd Farm," floor, then, will be a fun for idle people who can improve their health by exercising in such farms with earning. The electrical energy generated at such farms will be useful for nearby applications.



1.Top plate
2.Bottom plate
3.Rack
4.Pinion Gear
5.Dc Motor
6.Battery
8.Holdex Zero bulb
9.Springs

Fig 1: Schematic diagram of proposed system

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 in leading to worldwide drought and decertification. The buzzards of nuclear electric-stations are only too 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.

I. WORKING OF FOOT STEP GENERATOR

Step1: When force is applied on the plate by virtue on stamping on the plate the force spring gets compressed
Step2: The rack here moves vertically down
Step3: The pinion meshed with the rack gear results in circular motion of the pinion gear
Step4: For one full compression the pinion Moves 1semicircle
Step5: When the force applied on the plate released the pinion reverses and moves another semi-circle
Step6: The generator attached to the pinion hence results in the sinusoidal waveform (for single Generator)

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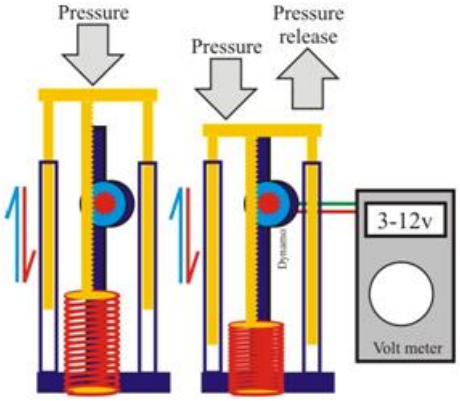

Fig 2: Operation Of Rack And Pinion Mechanisam

Operating Procedure

Whenever force is applied on the plate that force is converted to Electrical energy is used to drive DC loads. And that minute voltage which is stored in the Lead Acid battery. The battery is connected to the inverter. This 230 Volt A.C voltage is used to activate the conveyor belt. We are using conventional battery charging unit also for giving supply to the circuitry. Here the amount of battery gets charged whenever we place our foot on plate.Here we are using an inverter to convert dc to ac voltage by placing a load or a bulb. We can check the voltage values of particular load how much it is consuming with the help of LED or multi meter.

Rack And Pinion Mechanism:

A rack and pinion is a type of linear actuator that comprises a pair of gears which convert rotational motion into linear motion. A circular gear called "the pinion" engages teeth on a linear "gear" bar called "the rack"; rotational motion applied to the pinion causes the rack to move relative to the pinion, thereby translating the rotational motion of the pinion into linear motion. For example, in a rack railway, the rotation of a pinion mounted on a locomotive or a railcar engages a rack between the rails and forces a train up a steep slope. For every pair of conjugate involutes

profile, there is a basic rack. This basic rack is the profile of the conjugate gear of infinite pitch radius. A generating rack is a rack outline used to indicate tooth details and dimensions for the design of a generating tool, such as a hob or a gear shaper cutter. Rack and pinion combinations are often used as part of a simple linear actuator, where the rotation of a shaft powered by hand or by a motor is converted to linear motion.

The rack carries the full load of the actuator directly and so the driving pinion is usually small, so that the gear ratio reduces the torque required.

This force, thus torque, may still be substantial and so it is common for there to be a reduction gear immediately before this by either a gear or worm gear reduction. Rack gears have a higher ratio, thus require a greater driving torque, than screw actuators. A rack and pinion mechanism is used to transform the rotary motion in to linear motion and vice versa.A single gear, and pinion meshed with a sliding toothed rank. This combination is converts rotary motion in to back and forth motion. Windshield wipers in cars are powered by rack and pinion mechanism.

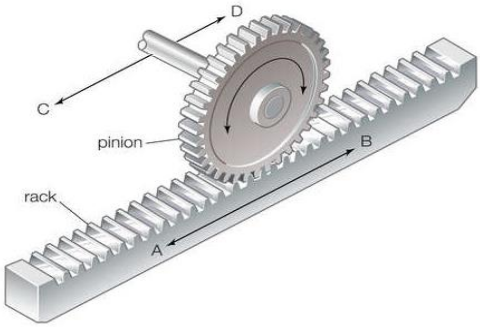

Fig 3: schematic diagram of rack and pinion tool

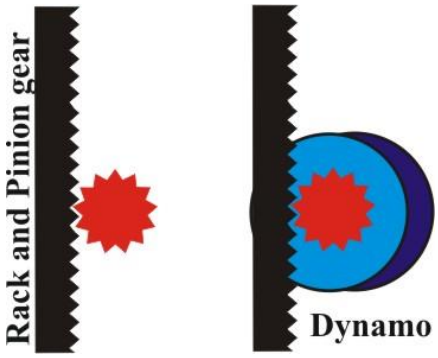

Fig 4: A rack and pinion mechanism

Different types of mechanisms

- Levers
- Gears

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- Wheels
- Cranks and ratchets
- Cams
- Rack & pinion
- Chain & Sprocket

Mechanisms require some type of Motion (movement)

There are four types of motion

- Linear
- Rotary
- Reciprocating
- Oscillating

The different types of forces are:

- Static- no movement (still force)
- Dynamic - moving forces
- Compression- squashing force
- Tension- pulling force
- Bending - compression and tension
- Torsion - turning or twisting
- Shear- cutting
- Equilibrium- all forces are balanced

II. INVERTER

An inverter is an electrical device that converts direct current (DC) to alternating current (AC); the converted AC can be at any required voltage and frequency with the use of appropriate transformers, switching, and control circuits. Solid-state inverters have no moving parts and are used in a wide range of applications, from small switching power supplies in computers, to large electric utility high-voltage direct current applications that transport bulk power. Inverters are commonly used to supply AC power from DC sources such as solar panels or batteries. There are two main types of inverter. The output of a modified sine wave inverter is similar to a square wave output except that the output goes to zero volts for a time before switching positive or negative. It is simple and low cost and is compatible with most electronic devices, except for sensitive or specialized equipment, for example certain laser printers. A pure sine wave inverter produces a nearly perfect sine wave output (<3% total harmonic distortion) that is essentially the same as utility-supplied grid power. Thus it is compatible with all AC electronic devices. This is the type used in grid-tie inverters. Its design is more complex, and costs 5 or 10 times more per unit power. The electrical inverter is a high-power electronic oscillator. It is so named because early mechanical AC to DC converters was made to work in reverse, and thus were "inverted", to convert DC to AC.The inverter performs the opposite function of a rectifier.

Circuit description:

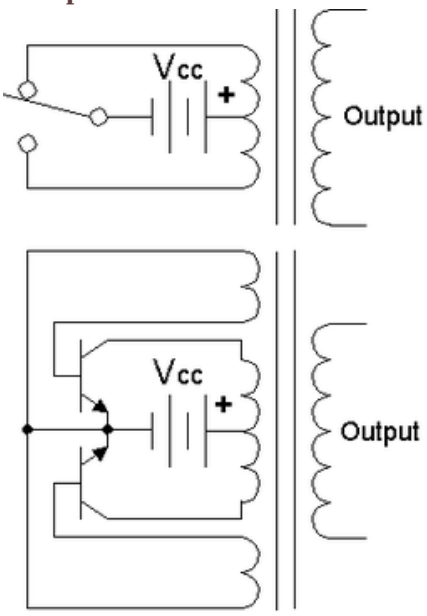

Fig 5: circuit diagram of inverter

In one simple inverter circuit, DC power is connected to a transformer through the centre tap of the primary winding. A switch is rapidly switched back and forth to allow current to flow back to the DC source following two alternate paths through one end of the primary winding and then the other. The alternation of the direction of current in the primary winding of the transformer produces alternating current (AC) in the secondary circuit. The electromechanical version of the switching device includes two stationary contacts and a spring supported moving contact. The spring holds the movable contact against one of the stationary contacts and an electromagnet pulls the movable contact to the opposite stationary contact. The current in the electromagnet is interrupted by the action of the

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switch so that the switch continually switches rapidly back and forth. This type of electromechanical inverter switch, called a vibrator or buzzer, was once used in vacuum tube automobile radios. A similar mechanism has been used in door bells, buzzers and tattoo guns.As they became available with adequate power ratings, transistors and various other types of semiconductor switches have been incorporated into inverter circuit designs.

I. DESIGN AND CALCULATION

Specification of Pinion

Material: cast-iron
Outside diameter: 25mm
Circular pitch: 3.14/25 = 0.1256mm
Pressure angle: 21
Pitch diameter: D=N/P = 0.8mm
Addendum: 1/25= 0.04mm
Dedendum: 1.157/25 = 0.04628mm
Circular tooth Thickness: 1.57/25 = 0.628mm

Design of Rack

Pitch circle diameter of the gear is =25
Circumference of the gear is = 3.14
Pitch circle diameter= 3.14x25 = 78.5mm

Specification of Rack

Material:cast iron
Width:1.5mm
Height:130mm

Generator

Speed: 300RPM
Type: DC geared motor

Battery

Capacity: 12V

Output Power Calculation

Let us consider,
The mass of a body = 60 Kg (Approximately)
Height after step = 13 cm
∴Work done = Force x Distance
Here,
Force = Weight of the Body
= 60 Kg x 9.81
= 588.6 N
∴Output power = Work done/Sec
= (588.6 x 0.13)/60
= 1.27 Watts

(For One pushing force) 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.

Voltage Regulator

A voltage regulator is an electrical regulator designed to automatically maintain a constant voltage level. It may use an electromechanical mechanism, or passive or active electronic components. Depending on the design, it may be used to regulate one or more AC or DC voltages. There are two types of regulator are they.
Positive Voltage Series (78xx) and
Negative Voltage Series (79xx)

78xx:

'78' indicate the positive series and 'xx'indicates the voltage rating. Suppose 7805 produces the maximum 5V.'05'indicates the regulator output is 5V.
These regulators consists the three pins there are
Pin1: It is used for input pin.
Pin2: This is ground pin for regulator
Pin3: It is used for output pin. Through this pin we get the output.

Fig 6: Regulator

Diodes:

Diodes allow electricity to flow in only one direction. The arrow of the circuit symbol shows the direction in which the current can flow. Diodes are the electrical version of a valve and early diodes were actually called valves. Diodes must be connected the correct way round, the diagram may be labeled a or + for anode and k or - for cathode (yes, it really is k, not c, for cathode!). The cathode is marked by a line painted on the body. Diodes are labeled with their code in small print; you may need a magnifying glass to read this on small signal diodes.

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EXPERIMENT:

Fig 7: Experimental Setup

Advantages:

- Simple technology and easy maintenance.
- No labor required.
- No fuel required.
- Pollution free power generation.
- This system does not depend on the weather like solar, wind and hydro power generations, so the energy available all around the year.
- This unit has minimum cost of installation.

Applications:

- Foot step generated power can be used for agricultural, home applications, street-lightening.
- Foot step power generation can be used in emergency power failure situations.

CONCLUSION:

In concluding the words of this paper, 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 so that increase the power production rate by fixing school and colleges, highways etc.

Future Scope:

Small changes in construction and design of the power generation set up can help to make the following future applications. Proposal for the utilization of waste energy of foot power with human locomotion is very much relevant and important for highly populated countries like India and China where the roads, railway stations, bus stands, temples, etc. are all over crowded and millions of people move around the clock. This whole human/bio energy being wasted if can be made possible for utilization it will be great invention and crowd energy farms will be very useful energy sources in crowded countries. Walking across a "Crowd Farm," floor, then, will be a fun for idle people who can improve their health by exercising in such farms with earning. The electrical energy generated at such farms will be useful for nearby applications.

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