Power Generation through Exercise Bicycle

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Abstract

This paper explores generating electricity through pedal power. It is not a new concept but it is no widely used. The concept of pedal generator is an efficient way to increase human awareness regarding energy conversion, energy consumption and energy loss through energy transmission.

Keywords: electricity generation, bicycle, sprocket, generator motor, chain drive

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I. INTRODUCTION

By adopting power-producing exercise machines in this way, gyms can promote themselves as environmentally friendly and also reduce their electric bills. Although the basic idea of attaching a generator to exercise equipment is many decades old, the press started lavishing attention on this concept four years ago, after a Hong Kong gym called California Fitness rigged 18 exercise machines to charge a battery and power fluorescent lights. Since then, three companies in the United States have been working hard to market the technology, each taking a slightly different approach.

II. MECHANISM OF OPERATION

The Pedal Operated Power Generator is a type of generators in which the source of mechanical power is provided by the human effort while spinning a shaft, with its corresponding angular speed (ωhuman) and torque (Thuman). Usually, a sort of mechanical transmission system is needed to adapt these variables into the generator's required ones (ωgen and Tgen). Then, this mechanical power is turned into electric power by the generator (Pout gen). Eventually, Poutgen is converted with the aim of being stored (Pin- storage), without damaging the storage system. The principle of using pedal motion to create the same motion as a motor can be translated to almost any device, and the parts needed are all the same, and in the case of the pedal powered electrical device, the components include: exercise bike, chain drive system, generator,voltmeter, battery and inverter system.

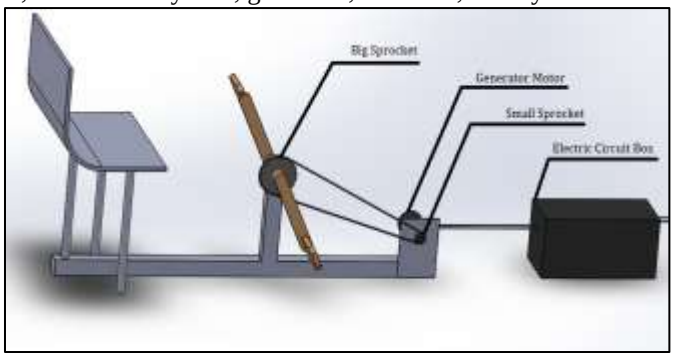

Fig. 1: Mechanism of Operation

The pedal input force, torque and power can be computed as below:

$$F_{input} = mv/t \quad (1)$$

$$\vec{T}_{input} = \vec{F}_{input}\, x\, \vec{r} \quad (2)$$

$$P_{input} = 2\pi NT/t \quad (3)$$

Where F is input force, T is input torque and P is input power.

A sprocket system consists of two sprockets each on a shaft, connected by a chain. This transmits rotary motion and force from the input, or driver shaft, to the output, or driven shaft. If the sprockets are different sizes, the smaller one will spin faster than the larger one. The difference in speed is called the velocity ratio. This is calculated using the formula:

Velocity ratio = diameter of the driven sprocket /diameter of the driver sprocket (4)

III. MAIN COMPONENTS

- Chain Drive System
- Shaft
- Generator Motor
- Battery
- Voltmeter
- Inverter(if required)

A. Chain Drive Systems:

Chain drives, gear drives and belt drive systems are all effective power transmission choices.
Each offers advantages and disadvantages with respect to the other.

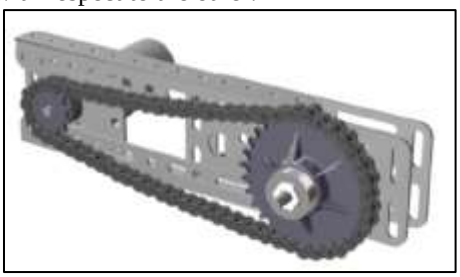

Fig. 2: Chain Drive System

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The advantages of chain drive systems are as follows:

1) Shaft center distances are relatively unrestricted. Whereas gear drive center-to-center distances are restricted to specific dimensions for a given set of gears, the center distances between two chained sprockets can vary anywhere from 50% to 300% or more of their pitch diameters.
2) Chain Drive are relatively easy to install. Assembly tolerances are not as restrictive as those for gear drives. Chain drives are a better choice for less experienced builders working with a minimum of machine tools.
3) Chain drives can be readily redesigned and reconfigured in comparison to gear drive systems.
4) Chains perform better than gears under shock loading conditions.
5) Chain drives spread operating loads over many teeth whereas the operating loads acting on gear drives are concentrated on one or two teeth.
6) Chain drives do not require tension on the slack side (Belt drives do) thus bearing loading is reduced.
7) Chain drives require less space for a given loading and speed condition than pulleys and belts.
8) Chain drives systems are *(usually)* less costly to build and maintain than an equivalent gear drive.

B. Shaft:

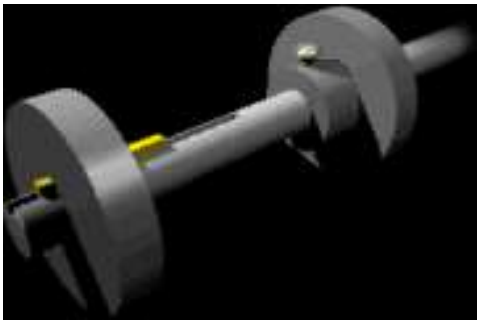

Fig. 3: Shaft

A shaft is a rotating machine element, usually circular in cross section, which is used to transmit power from one part to another, or from a machine which produces power to a machine which absorbs power.[1] The various members such as pulleys and gears are mounted on it.

C. *Generator Motor:*

Fig. 4: Generator motor

A motor–generator (an M–G set) is a device for converting electrical power to another form. Motor–generator sets are used to convert frequency, voltage, or phase of power. They may also be used to isolate electrical loads from the electrical power supply line. Large motor–generators were widely used to convert industrial amounts of power while smaller motor–generators (such as the one shown in the picture) were used to convert battery power to higher DC voltages.

D. *Battery:*

Fig. 5: Battery

A battery is a device consisting of one or more electrochemical cells with external connections provided to power electrical devices such as flashlights, smartphones, and electric cars. When a battery is supplying electric power, its positive terminal is the cathode and its negative terminal is the anode. The terminal marked negative is the source of electrons that will flow through an external electric circuit to the positive terminal. When a battery is connected to an external electric load, a redox reaction converts high-energy reactants to lower-energy products, and the free-energy difference is delivered to the external circuit as electrical energy. Historically the term "battery" specifically referred to a device composed of multiple cells, however the usage has evolved to include devices composed of a single cell.

E. *Voltmeter:*

Fig. 6: Voltmeter

A voltmeter is an instrument used for measuring electrical potential difference between two points in an electric circuit. Analog voltmeters move a pointer across a scale in proportion to the voltage of the circuit; digital voltmeters give a numerical display of voltage by use of an analog to digital converter.

F. Inverter

Fig. 7: Inverter

A power inverter, or inverter, is an electronic device or circuitry that changes direct current (DC) to alternating current(AC). The input voltage, output voltage and frequency, and overall power handling depend on the design of the specific device or circuitry. The inverter does not produce any power; the power is provided by the DC source.A power inverter can be entirely electronic or may be a combination of mechanical effects (such as a rotary apparatus) and electronic circuitry. Static inverters do not use moving parts in the conversion process.

IV. CONCLUSION

Hence, in this way power is generated by the human effort applied on pedal of exercise bike. With the help of this machine we can generate power which can be stored in the battery as well as human can do exercise which is good for health.

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