

HUMAN POWERED POWERGENERATING SYSTEM

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ABSTRACT:

Human powered generators have been of interest at many places where no other alternative electricity generator has been available. While using pedal power is not a new concept in itself, it has not been successfully used on wider scale. Power generated by human can be converted from mechanical to electrical energy by using either a dynamo or an alternator. This principle can be extended to power mobiles, iPods⁷, laptops home appliances etc. Power can also be generated from the human efforts or human energy. This human energy can be given to the driving wheel and with this driving wheel to alternator can produce the power and finally we can use this power for different applications like as early as stated. In this paper we proposed one new system for generating the power with the help of this system the person can maintain a good physic and along with it power can also be generated. This paper presents methods to generate electricity by pedaling. It also explains in detail the method using alternator to generate the power.

Key Words: Alternator, driving wheel, pedaling.

HISTORY:

India is the second most populous nation in the world. Like many other countries where agriculture is the main activity, biomass and other non-commercial fuels constitute around 40% of energy requirement in India. Around 85.49% of Indian villages are electrified; many will not be electrified for considerable time. The consumption of electricity in the country is increasing at the rate of 10% per year. The energy usage has been increasing through years, but there has been no sufficient increase in the production.

WHY PEDAL POWER:

We explored lot of different ways of lighting the rooms. The requirements were quite minimal, only lighting was the basic need. We considered solar photovoltaic, pressure kerosene lamps, liquid petroleum gas fired mantle lamps etc. Ideal would have been the photovoltaic system but it is prohibitively expensive in India. Therefore we decided to develop a power generation system with pedaling or human energy for battery charging.

Pedal power by itself is not a new concept but is not widely used. The basic idea was to pedal at a comfortable speed and still generate enough power to make it worthwhile. We felt a ratio of 1:3 to 1:5 of pedaling time to lightly time would be encouraging enough to use this way of lighting and we felt that this could be achieved by using compact fluorescent lamps.

INTRODUCTION:

Throughout history human energy has generally been applied through the use of the arms, hands, and back. With minor exceptions, it was only with the invention of the sliding-seat rowing shell, and particularly of the bicycle, that legs also began to be considered as a "normal" means of developing power from human muscles.

A person can generate four times more power (1/4 horsepower (hp)) by pedaling than by hand-cranking. At the rate of 1/4hp, continuous pedaling can be done for only short periods, about 10 minutes. However, pedaling at half this power (1/8 hp) can be sustained for around 60 minutes. Pedal power enables a person to drive devices at the same rate as that achieved by hand-cranking, but with far less effort and fatigue. Pedal power also lets one drive devices at a faster rate than

before, or operate devices that require too much power for hand-cranking.

Over the centuries, the treadle has been the most common method of using the legs to produce power. Treadles are still common in the low-power range, especially for sewing machines. Historically, two treadles were used for some tasks, but even then the maximum output would have been quite small, perhaps only 0-15 percent of what an individual using pedal operated cranks can produce under optimum conditions.

However, the combination of pedals and cranks, which today seems an obvious way to produce power, was not used for that purpose until quite recently. It was almost 50 years after Karl von Kraus invented the steerable foot-propelled bicycle in 1817 that Pierre Michaud added pedals and cranks, and started the enormous wave of enthusiasm for bicycling that has lasted to the present.

The main use of pedal power today is still for bicycling, at least in the high-power range (75 watts and above of mechanical power). In the lower-power range there are a number of uses of pedal power--for agriculture, construction, water pumping, and electrical generation--that seem to be potentially advantageous, at least when electrical or internal-combustion engine power is unavailable or very expensive.

Pedaling Rate:

How fast should a person pedal? Human beings are very adaptable and can produce power over a wide range of pedaling speeds. However, people can produce more power--or the same amount of power for a longer time--if they pedal at a certain rate. This rate varies from person to person depending on their physical condition, but for each individual there is a pedaling speed somewhere between straining and flailing that is the most comfortable, and the most efficient in terms of power production. (For centuries, this fact was apparently not recognized.

The predominant method of human power production was to strain with maximum strength

against a slowly yielding resistance. This is neither comfortable nor efficient. Neither is the opposite extreme of flailing at full speed against a very small resistance.

A simple rule is that most people engaged in delivering power continuously for an hour or more will be most efficient when pedaling in the range of 50 to 70 revolutions per minute (rpm).

Gear Ratios

The relationship between the rotating speed of whatever is being driven and the pedaling rate (both expressed in revolutions per minute) is called the gear ratio. Most practical applications of Pedal power will use bicycle-chain drives, which on bicycles range from 1:1 (the rear wheel turns at the same speed as the turns at five times the speed of the cranks) for high gears.

Power generation using pedaling:

There are various renewable energy sources such as solar, wind, hydro power etc. In addition, people use fossil fuels which are non-renewable. These resources are very expensive; therefore there is a need for cheap, renewable energy source. As long as we are pedaling and the system is working fine, we can get the power whenever needed. Power generation using bicycle is very cheap and eco-friendly. Even though people have been using pedal power for various day-to-day works.

The rotational energy that is generated when the pedaling rotates because of the application of force on the pedals can be used in two ways. This energy can also be used in dynamo/alternator, which is then converted to electrical energy.

Dynamo:

Dynamos are alternators equipped with permanent magnets, which produces ac current. Two types of dynamos are available i.e., hub dynamo and bottle dynamo. Hub dynamo is built into the hub of the bi-cycle wheel. Here generation of electricity is done by using the rotation of the bi-cycle wheel. A bottle dynamo is also a small

electric generator like hub dynamo. It is generally placed to the rear wheel of the bi-cycle. A bottle dynamo acts like a small alternator.

Dynamo can be used to convert mechanical energy to electrical energy alternating current can be produced normally using the dynamo. This current can power devices which work on AC directly and can be converted and used for devices working on DC. The amount of power generated from a dynamo by pedaling is sufficient to power the devices, which require low power. Most of the electronic devices including mobile phones and iPods can be powered using this. These devices can be charged while either riding the bi-cycle or by keeping the bi-cycle stationary and pedaling. Dynamo is small light weight and is best to use in bi-cycles.

Alternator:

An alternator is nothing but an AC generator which is machine that converts mechanical energy into electrical energy. Generators are subdivided in to two categories depending upon whether the electric current produced is alternating current (AC) or direct current (DC). The basic principle on which both types of alternators work is the same, although the details of construction of the two may differ somewhat.

Principle of Operation:

In 1820, Danish physicist Hans Christian Oersted (1777-1851) discovered that an electric current created a magnetic field around it. French physicist Andre Marie Ampere (1775-1836) then found that a coil of wire with current running through it behaved just like a magnet.

In about 1831, English physicist Michael Faraday (1791-1867) discovered the scientific principle on which generator operates, electromagnetic induction. By reversing the work of Oersted and extending the work of Ampere, Faraday reasoned that if a current running through a coiled wire could produce a magnetic field, then a magnetic field could induce a current of electricity

in a coil of wire. By moving a magnet back and forth in or near a coil of wire he created an electrical current without any other source of voltage feeding the wire.

System setup for power generation:

In this work we basically use the human energy i.e. a person can put his effort to rotate the pedals, this we can call it as pedaling. This pedaling gives the rotational work or mechanical energy. This mechanical energy is converted into electrical energy by means of the components used in the system.

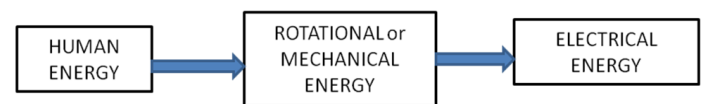


Fig. 1. Line diagram for energy transformation

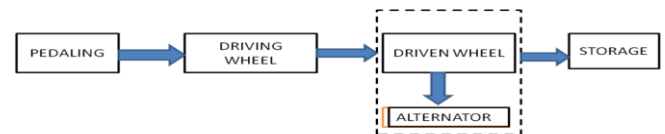


Fig:2 Line diagram for the working of the system

Fig. 3 shows the system set up, we used this system to charge the batteries. In this system, an alternator is attached to the follower for power generation. When the person gives the motion to the pedals, that pedal motion transferred to the driver, and this driver is directly connected to the pedals, and this driver is also in contact with the driver/follower and this follower is directly connected to the alternator, with this alternator results in the rotational motion of the follower (of the alternator). This motion causes the alternator to produce electrical energy (AC).

Components used in the system for power generation:

The following are the basic components we used to convert the rotational or human power to the electric power.

S.No.	Name of the Components
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01.	Table
02.	Pedals
03.	Driver 750mm
04.	Driven/follower 75mm
05.	Ball Bearings
06.	Alternator 300W
07.	Battery

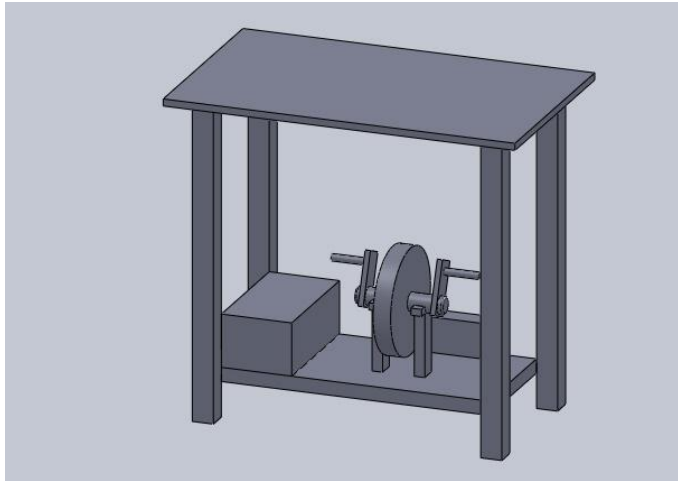


Fig. 3 system setup

Model Calculations:

Let diameter of the driver = 750mm

Diameter of the follower = 75mm

Speed of the follower = 1000rpm

Speed of the driver = ?

$$\frac{\text{Speed of the driver}}{\text{Speed of the follower}} = \frac{\text{Diameter of the follower}}{\text{Diameter of the driver}}$$

$$\frac{\text{Speed of the driver}}{1000} = \frac{75}{750}$$

Speed of the driver = 100 rpm

Initial speed required is 100rpm and which is given by pedaling, up to certain time (10seconds) to attain certain speed and then after if we increase the pedaling speed the power developed is also increased and that power we can store in a battery and this developed power can be utilized wherever required for several applications.

Once we give 100rpm initially and this can be increased to 1000rpm by the diameter ratio or gear ratio and according to the model calculations it shows that the basic assumption values of the driver and the driven/ follower diameter and the speed of the follower can be assumed as 750mm, 75mm and 1000rpm and which depends upon the minimum speed required to generate the power from alternator.

Applications:

Pedal Power For Transportation

The principal use of pedal power around the world is for the transportation of people and goods.

A bicycle used by itself can carry a rider, plus 50 to 100 kilograms of goods in a front and/or rear carrier on the cross-bar, or on the rider's head. The carrying capacity of a bicycle can be greatly increased by attaching a trailer to it. One model of trailer has seats for two adults, and allows the bicycle to be easily converted into a rickshaw.

A rickshaw is usually made from the front or rear-portion of a standard bicycle, connected to a load-carrying platform over a two-wheel axle. Rickshaws can carry an extraordinary quantity of people and goods.

Other Uses Of Pedal Power

Broadly speaking, applications of pedal power are possible when the power level required is below a quarter of a horsepower (that is, below about 200 watts). Common applications of stationary pedal power include pumping water, grinding grains or metals, shredding, or threshing. Pedal power can also be used to generate electricity for individual uses--to operate room lights, a television set, or a projector, for example. Surplus power could be diverted to a battery-charging circuit. The easiest way to do this is simply to drive either a DC generator or an AC alternator through a circuit feeding a battery in parallel with the load.

The same circuit could be used for an alternator of higher power, chain-driven from the cranks, through an appropriate gear ratio.

Other pedal power applications include:

- Cassava graters
- Coffee pulpers
- Coffee/grain hullers
- Cracking of oil palm nuts
- Fiber decorticaters--sisal, manila, hemp, etc.
- Winches or hoists
- Balers
- Potter's wheels
- Flexible shaft drive for portable grinders, saws, etc.
- Tire pumps
- Sewing machines

The use of pedal power for agricultural implements that have to move across soft or uneven ground is not recommended. A mower described and illustrated in *Bicycling Science* required so much energy to move the mower across the ground that a small proportion of the rider's total energy went into mowing. This loss of energy would occur for any use--like plowing, cultivating, or harrowing--in which the vehicle had to move across the ground. McCullagh's *Pedal Power* describes some designs in which the pedaling unit is stationary at one edge of the plot, while the plow or other implement, guided by a second worker, is pulled by a rope or chain. This principle should be tried out further.

CONCLUSION:

The lack of available electrical power is a significant issue and it affecting communication, education and safety. a reliable source of renewable electric energy could provide solutions to these critical problems. Communication could be improved by allowing people to charge the mobile phones. an inexpensive source of electric power could provide light, allowing children's to study after dark. the electric lighting could reduce the

need for potentially dangerous candles, fires, and kerosene lamps.

The system described above is being developed with these problems in mind. it is being designed with specific goals to make the greatest impact possible with multy tasks. low cost, portability, reliability, and ease of use are all essential to the success of the system.

REFERENCES:

1. Darrow, Ken, and Pam, Rick. "Energy: Pedal Power," from *Appropriate Technology Sourcebook* pp.189-196. Stanford, California: Volunteers in Asia, Inc., 1977.
2. Kerr, Richard. *Rickshaw Study -- Bangladesh*. Ottawa, Canada: Inter Pares, 1983. (Draft.)
3. McCullagh, James C., editor. *Pedal Power*. Emmaus, Pennsylvania: Rodale Press, 1974.
4. "Pedal Power," a supplement to *Energy for Rural Development*. Washington, D.C.: National Academy Press, 1981, pp. 137-148.
5. Weir, Alex. *Four-Person Pedal-Powered Grain Thresher/Mill*. Arlington, Virginia: Volunteers in Technical Assistance (VITA), 1979.
6. Weir, Alex. *The Dynapod: A Pedal-Power Unit*. Arlington, Virginia: Volunteers in Technical Assistance (VITA), 1980.
7. Whitt, Frank Rowland, and Wison, David Gordon. *Bicycling Science*. 2nd ed. Cambridge, Massachusetts: The MIT Press, 1983.
8. http://www.alternative_energy_news.info/Technology/human_powered/pedal_power
9. Statistics, "No. of towns and villages electrified in India".
10. http://www.appropedia.org/Rowan%275_portable_pedal_power_generator