FLYWHEEL BASED BICYCLE GENERATOR

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ABSTRACT

Transportation is very important connecting people from different places. A mode of transport is a solution that makes use of a particular type of vehicle, with the increase in population the number of vehicles on road is also increasing. The transportation plays a major impact on environmental-creates air pollution, including nitrous oxide and other particulates and is a significant contributor to global warming through emission of co2. This paper presents a Flywheel based Bicycle Generator. A mode of transportation due to their low cost, ease of use, health benefits and mobility. The main objective of this paper is to convert the rotational energy of rare wheel of the bicycle into electrical energy so that we can recharge the battery.

1. INTRODUCTION

The cost of fossil fuel is increasing day by day as well as government policy is also towards the minimization of atmospheric pollution. Bicycle is an economical and pollution free vehicle for controlling the atmospheric pollution, which is not depending on crude oil. Government is also taking many steps to make use of renewable resources.The use of fossil fuels and other non-reusable sources of energy must be reduced to keep emissions low and alleviate the use of diminishing resources. The idea of human powered generation has been implemented in many different situations. Some examples include hand-crank radios, shaking flashlights, and receiving power from gym equipment (William and Jeffrey, 2012). The use of exercise equipment for a clean source of energy would be an even more fun experience for participants and provide a means to exercise and generating power.

The flywheel based bicycle generator utilizes human energy to produce electricity quickly and efficiently. The goal is to provide technological solution to problem in the rural world by using detailed opportunity recognition, evaluation, and development of prototype. The prototypes are then turned over to the developing world for manufacturing, distribution and use. Less commonly, pedal power is used to power agricultural and hand tools and even to generate electricity. Some applications include pedal powered laptops, pedal powered grinders and pedal powered water wells. Some third world development projects currently transform used bicycles into pedal powered tools for sustainable development.

Human powered generation gives a power source that is not directly derived from natural sources. An example is a human powered generator operated in absence of solar irradiation, wind and water. The power generated from pedal is perfect for remote areas, hilly regions, strategic location, Islands etc., where electricity generation is scanty if not nil. In these situations, a small portable power generating unit would be of great help to provide power supply to charge battery-operated gadgets like mobile phones, lamps, radio, communication devices, etc. A new way to bring power to the people as population continues to grow and power shortages continue to occur. This design relates to very compact and easily portable power-generating unit, besides being used as a power generator can also be used as cycle exerciser. It serves dual purpose of power generation and helping the person

to maintain physical fitness through exercise of muscles of legs. It can be pedalled or cranked by hand/foot to charge 12 volt batteries and run small appliances.

2. LITERATURE SURVEY

Throughout human history, 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 (Wilson, 1986). 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 Innovative Systems Design and Engineering 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 Krais 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. Ever since the arrival of fossil fuels and electricity, human powered tools and machines have been viewed as an obsolete technology. This makes it easy to forget that there has been a great deal of progress in their design, largely improving their productivity. The most efficient mechanism to harvest human energy appeared in the late 19th century pedaling. Stationary pedal powered machines went through a boom in the turn of the 20th century, but the arrival of cheap electricity and fossil fuel abruptly stopped all further development (Kris, 2011). Otto Von Guericke is credited with building the first electrical machine in 1660. This form of electricity precedes electromagnetic energy which dominates today. The landscape for today's electricity usage practices bloomed from 1831 to 1846 with theoretical and experimental work from Faraday, Weber and Gauss in the relationship of current, magnetic fields and force. These theories enabled the design modern motors and generators. From 1880 to 1900, there was a period of rapid development in electrical machines. Thus this section reviews the works that has been done on human power generation.

***KERS Bicycle*:**

Mechanical kinetic energy recovery bicycle by use of flywheel was done by Athlone Institute of Technology, Westmeath, Ireland. Maxwell von Stein's Flywheel Bicycle stores the power that would otherwise be wasted in the braking process. In order to help boost their range, many electric and hybrid cars employ regenerative technology where braking energy is stored in the battery instead of simply being wasted. Maxwell von Stein, a student at New York City's Cooper Union for the Advancement of Science and Art, thought of implementing a flywheel to an existing bicycle, in order to harness the energy that's lost during braking. That energy can then be used to boost the bike when needed. The Flywheel Bicycle has a continuously variable transmission in the rear hub. This is linked to a 6.8 kilogram (15 lb) flywheel from a car engine mounted in the middle of the frame. When the cyclist wishes to slow down, such as when they're going down a hill or coming to a stop, they shift the transmission to maximize the flywheel-speed-to-bike-speed ratio. This "charges" the flywheel with kinetic energy - effectively a mechanical version of what happens in an EV where a battery stores the scavenged energy. Once they want to accelerate or climb a hill, they do the opposite - they shift the transmission to minimize the ratio. This lets the energy stored in the flywheel drive the transmission, giving the bike and its rider a boost.

3. BASIC CONFIGURATIONS OF BICYCLE GENERATOR

The basic configuration of a bicycle generator consists of rider input where rider releases energy through pedals. This input energy from rider is further passed to gears and drive wheel of the bicycle. The flywheel which is connected to rotor of generator starts rotating. Once generator meets sufficient speed, it starts to generate voltage. This generated is sent to booster circuit which provides sufficient constant voltage to the battery to charge as shown in Fig 1.

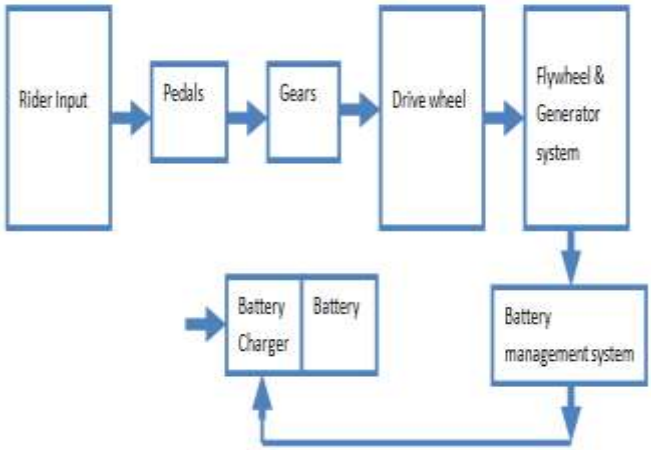

Fig-1:Block diagram showing the Energy conversion loop

4. COMPONENTS SPECIFICATION

Generator: Permanent Magnet DC Generator is used in the experiment. Ratings of this generator are 16V, 2A, 1000RPM. This generator gets almost constant amount of speed as input to rotor since flywheel is used.

Flywheel: A flywheel is a mechanical device specifically designed to efficiently store rotational energy. Flywheels resist changes in rotational speed by their moment of inertia. The amount of energy stored in a flywheel is proportional to the square of its rotational sped. Flywheels are also used to provide continuous power output in systems where the energy source is not continuous. The flywheel used is of 17cm Dia, 0.8cm Width and 2.5kg weight.

LI-PO Battery bank: A Lithium-Polymer battery is rechargeable battery of lithium-ion technology using a polymer electrolyte instead of more common liquid electrolyte. Here 12V, 4.4AH battery bank is being used.

Belt Drive System: A belt is a loop of flexible material used to link two or more rotating shafts mechanically. Belts are used to transmit power more efficiently. Belts need not to be axially aligned.

5. DESCRIPTION OF BICYCLE GENERATOR

For the experimental investigation bicycle generator with a Permanent Magnet Direct Current (PMDC) generator is mounted above the rear wheel of the bicycle with flywheel connected to generator shaft is as shown in Fig.2. This Flywheel is driven by pulleys drive system. The generator produces 30w of power when the bicycle is rode at 10kmph. This generated power is stored in the lithium polymer battery bank of 12v 4.4ah. The battery bank is protected by battery management system (BMS), which protects battery from over charge, over discharge and short circuit. These charged batteries can be used to light homes, to charge electronic devices and can also be used to pedal assist while riding in uphill. While moving up-hill, the rider has to pedal with more power in order to run the cycle upwards in this situation running generator simultaneously is impossible, so a clutch system is used where it separates the flywheel and generator system from rare wheel.

Fig.2: Bicycle generator with a Permanent Magnet Direct Current (PMDC) generator

6. INVESTIGATION OF GENERATED VOLTAGE AND CURRENT

The experimental prototype, rider is made to ride bicycle in downhill (15KMPH) and straight road(10KMPH), the corresponding values of generated voltage and current when connected to a battery bank of 12V 4.4AH are in given in Table-1.

TABLE-1:GENERATED VOLTAGE AND CURRENT FOR A BATTERY BANK OF 12V 4.4AH

	Speed (kmph)	Voltage (v)	Current (A)
Straight Road	8-10	14-15	0.7
Downhill	12-15	15-15.5	1-1.5

7. CONCLUSION

Bicycle generator can be effectively used to charge the batteries while riding. It can also be used as exercise bicycles in homes, gyms and also in parks. This can also be used as off-grid generator along with solar power system. Some of the merits of the bicycle include: Pollution free, Low maintenance, Long life, User Friendly, Effectively used in all seasons, Ease of access etc., Some of the disadvantages are: No generation action when moving in uphill, Li-Po batteries are costly. Though, much was covered in the analysis future work includes a) A battery with higher Amp-hour range to for longer discharge time with more load if it is to serve more number of persons at a time and to run the cycle as E-bike. Some of the applications include: Energy storied in batteries can be reused to run the cycle as E-bike, Helpful for people in rural areas, Can be effectively used during night time, Charged batteries can be used in UPS.

8. REFERENCES

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