Proceedings of the
International Conference on Mechanical Engineering and Renewable Energy 2013
(ICMERE2013) 1 – 3 May 2014, Chittagong, Bangladesh

ICMERE2013-PI-285

DESIGN & FABRICATION OF A PEDAL POWERED MOBILE PHONE CHANGER

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Abstract- *Mobile phone has become very effective tool in modern world mode of communication. In developing countries like Bangladesh it is easily accessible. But the problem is how to charge a phone when the national grid electricity supply is not available .The aim of this research is to develop a pedal power generation system. By this system we can produce about 7 volt and 0.4 amp corresponding to the pedal about 1221.5 rpm. This power is stored in a 6 volt lead acid battery. At least one mobile can be charged by this battery when the bi-cycle is in rest.*

Keywords: Mobile phone, Communication, Pedal Power, Charge.

1. INTRODUCTION

Energy is the capacity of a system to do work. That system may be a jet, carrying hundreds of passengers across the ocean. A baby's body, growing bone cells. A kite, rising on the wind. Or a wave of light crossing a space. In moving or growing, each of these systems is doing work, and using energy. Every living organism does work, and needs energy from food or photosynthesis. Humans also create machines that do work for them, and that derive energy from fuels. One form of energy can be converted to another form. This transfer is based on the law of conservation of energy—one of the laws of thermodynamics. Humans converted energy from one form to another when they lit the first fire. By burning wood, they released the chemical energy stored in the bonds of the wood molecules, generating thermal energy, or heat. Other examples? A battery generates electrons from chemical reactions, which are used to make electrical energy. A toaster takes electrical energy and converts it to heat. Your leg converts the chemical energy stored in your muscles into kinetic energy when you pedal a bicycle[1].

Pedal power is the source of getting energy from human being. It can be described as the transfer of energy generated through the movement of human feet and hands in some cases. The use of pedal power also strengths the muscles. The use of pedal developed over a time. However nowadays it has become a useful and economical way of generating energy. The energy generated in this process is also used to produce electricity. Worldwide especially in the underdeveloped countries use of bicycle pedals is still the key to run industry. This practice is common to these countries in order to save electricity and labor costs. Pedal power has been utilized in a really efficient manner and really unique tools have been introduced[2]. Some of the greatest inventions of the century using pedal power are pedal power laptops, pedal power snowplow, pedal power wheel chairs, and pedal powered dynamo. These machines have not helped the human race to perform physical activities, but over the years it has proved to be an effective source of energy generation. Another amazing creation to utilize pedal power is pedal power generators. Pedal power generators produce electric current in few minutes and allow one to charge the batteries of all kinds. Various forms of batteries which can be charged include laptop, mobile, cameras and ipod batteries[3].

The aim of this research is to design and fabrication of a pedal power generation system and the mobile charging system for the people of the village.

2. MAIN COMPONENTS OF THE PEDAL POWERED MOBILE CHARGING SYSTEM

To make the pedal powered mobile charging system the following items are required (Table 1):

Table 1: Components of the pedal powered mobile charging system

Bi-cycle	Rectifier
Bottle Dynamometer (6V, 2.8W)	Diode
Lead acid battery (6 V)AC	Charger
Capacitor	Jack

2.1 Bottle Dynamo:

A bottle dynamo or sidewall dynamo is a

small electrical generator for bicycles employed to power a bicycle's lights. The traditional bottle dynamo is not actually a dynamo, which creates DC power, but a low-power magneto that generates AC. Newer models can include a rectifier to create DC output to charge batteries for electronic devices including cell phones. Named after their resemblance to bottles, these generators are also called sidewall dynamos because they operate using a roller placed on the sidewall of a bicycle tire. When the bicycle is in motion and the dynamo roller is engaged, electricity is generated as the tire spins the roller[4]. The Bottle Dynamo that is used in this project have Output Voltage : 6 Volt and Watts in Dynamo: 2.8 W

2.2 Lead Acid Battery:

The lead acid storage battery **is** formed by dipping lead peroxide plate and sponge lead plate in dilute sulfuric acid. A load is connected externally between these plates. In diluted sulfuric acid the molecules of the acid split into positive hydrogen ions (H^+) and negative sulfate ions (SO_4^{--}). The hydrogen ions when reach at PbO_2 plate, they receive electrons from it and become hydrogen atom which again attack PbO_2 and form PbO and H_2O (water). This PbO reacts with H_2 SO_4 and forms $PbSO_4$ and H_2O (water).

SO_4^{--} ions are moving freely in the solution so some of them will reach to pure Pb plate where they give their extra electrons and become radical SO_4. As the radical SO_4 cannot exist alone it will attack Pb and will form $PbSO_4$.

As H^+ ions take electrons from PbO_2 plate and SO_4^{--} ions give electrons to Pb plate, there would be an inequality of electrons between these two plates. Hence there would be a flow of current through the external load between these plates for balancing this inequality of electrons[5]. The Specification of LeadAcid Battery used in this project are Types of Battery: Rechargeable and Output voltage: 6Volt

2.3 Capacitor

A capacitor (originally known as a condenser) is a passive two-terminal electrical component used to store energy electrostatic ally in an electric field. The forms of practical capacitors vary widely, but all contain at least two electrical conductors separated by a dielectric (insulator); for example, one common construction consists of metal foils separated by a thin layer of insulating film. Capacitors are widely used as parts of electrical circuits in many common electrical devices. When there is a potential difference (voltage) across the conductors, a static electric field develops across the dielectric, causing positive charge to collect on one plate and negative charge on the other plate. Energy is stored in the electrostatic field. Capacitors are widely used in electronic circuits for blocking direct current while allowing alternating current to pass. In analog filter networks, they smooth the output of power supplies. In resonant circuits they tune radios to particular frequencies. In electric power transmission systems they stabilize voltage and power flow. Capacitors are connected in parallel with the power circuits of most electronic devices and larger systems (such as factories) to shunt away and conceal current fluctuations from the primary power source to provide a "clean" power supply for signal or control circuits. The capacitors act as a local reserve for the DC power source, and bypass AC currents from the power supply[6].

2.4 Rectifier:

A rectifier is an electrical device that converts alternating current (AC), which periodically reverses direction, to direct current (DC), which flows in only one direction. The primary application of rectifiers is to derive DC power from an AC supply. Virtually all electronic devices require DC, so rectifiers are used inside the power supplies of virtually all electronic equipment. Converting DC power from one voltage to another is much more complicated. One method of DC-to-DC conversion first converts power to AC (using a device called an inverter), then use a transformer to change the voltage, and finally rectifies power back to DC. A frequency of typically several tens of kilohertz is used, as this requires much smaller inductance than at lower frequencies and obviates the use of heavy, bulky, and expensive iron-cored units[7].

2.5 Diode:

A Diode is an electrical component that's main function is to allow an electric current to pass one way, known as the diode's forward direction. While also blocking a current from the opposite direction, known as the reverse direction. Typically a two-terminal design with asymmetric conductance, the diode has ideally zero resistance to the current flow in one specific direction while ideally infinite resistance from the other direction. The most common type of diode used today would be the semiconductor[8].

2.6 Zener Diode :

A Zener diode is a diode which allows current to flow in the forward direction in the same manner as an ideal diode, but also permits it to flow in the reverse direction when the voltage is above a certain value known as the breakdown voltage, "zener knee voltage", "zener voltage" or "avalanche point". Zener diodes are widely used as voltage references and as shunt regulators to regulate the voltage across small circuits. When connected in parallel with a variable voltage source so that it is reverse biased, a zener diode conducts when the voltage reaches the diode's reverse breakdown voltage. From that point on, the relatively low impedance of the diode keeps the voltage across the diode at that value.
Zener diodes are a form of semiconductor diode that are widely used in electronics circuits as voltage references. Zener diodes provide a stable and defined voltage and as a result Zener diode circuits are often used in power supplies when regulated outputs are needed. Zener diodes are cheap and they are also easy to use and as a result they are used in many applications and many circuits.[9]

3. STRUCTURAL DESIGN AND FABRICATION

3.1 Design:

Design is a subject of problem solving constraints. The supply of electricity is inadequate in many remote areas in the developing countries like Bangladesh. Mobile

phone is an integral part of our daily lifestyle. So we have designed a pedal power generation system in which we have used a bottle dynamo(6V,2.8W), Lead acid Battery(6V,4.5Ah), Capacitor(100µF), Diode, Zener diode, Rectifier(6V) & Resistance(5Ω,10Ω).

3.2 Fabrication of The System:

Mechanical: At first we have clamped the dynamo in the rear wheel of the bi-cycle. The dynamo roller is engaged in such a way that when the wheel rotates the roller also rotate at a certain rpm and generate AC voltage.

Electrical: In this arrangement, we have used rectifier, resistance, lead acid battery ,diode and Zener diode. The diode, resistance, positive terminal of the capacitor and Zener diode is connected with the positive terminal of the rectifier and finally to the positive terminal of the Battery. The negative terminal of the capacitor and zener diode is connected to the negative terminal of the Rectifier and finally this connection goes to the negative terminal of the battery. Then another resistance is connected to the battery

3.3 Circuit Diagram and Electronic Hardware

In this circuit, the microcontroller gives input to the servo motor by using port B. For this purpose pin B6 and B7 are used. By the pin B4, microcontroller gives input to the magnet circuit with the help of transistor BC555. For magnetic signal LED (green) is used at the pin B4 between microcontroller and transistor. Here input voltage is 6V which is used for servo motor and transistor. Voltage regulator (LM7805) converts this 6V to the 5V for microcontroller (Fig.1 and Fig.2).

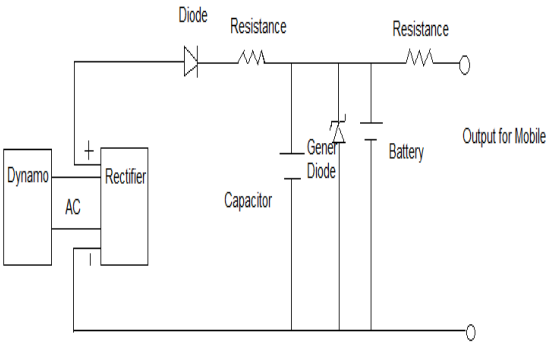

Figure 1: Circuit diagram

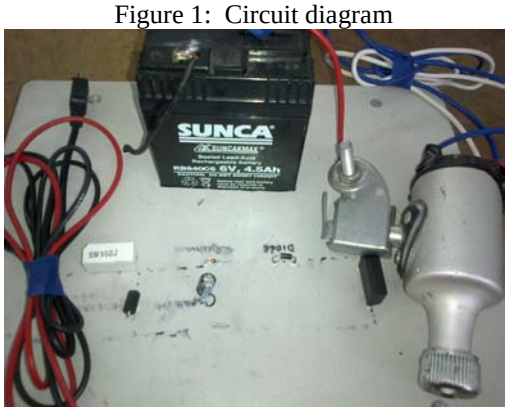

Figure 2: Total electrical charging system

4. WORKING PRINCIPLE

4.1 Flow Chart

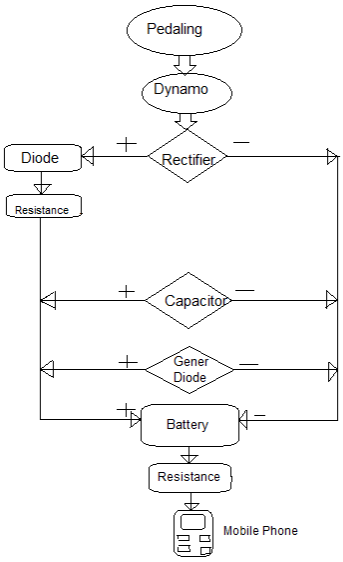

Figure 3 : Working flow chart of the charging system

Figure 4 : Complete mobile charging system

From the Fig.3 and Fig.4 it seen that while pedaling, the dynamo produces AC voltage. The rectifier then rectifies back to DC voltage. But we don't get the 100 percent DC voltage, so we have used a diode for achieving the 100 percent DC voltage and a resistance for a minimum amount of voltage drop in the positive terminal of the rectifier. This is connected to the positive terminal of the Battery. Again we have connected a capacitor for smoothing the output of power supply and a zener diode for adjusting the voltage to the required value. It is connected to the negative terminal of the battery and the battery is charged. We have used another resistance for voltage drop .Because for an electrical system to be more useful the maximum voltage drop should be considered. Finally the mobile is charged.

5. RESULTS AND DISCUSSION

5.1 Experimental results:

It has been seen from Table 1 that when the rpm range is 1221.5 then the voltage storage in the battery is 6.5V. So, a 6 volt Lead Acid Battery can be charged by the dynamo rpm 1221.5.

Table 1: Voltage generation vs dynamo rpm

RPM of Dynamo	Voltage Generated(V)	Current (amp)	Voltage Generated in Battery(V)
163.6	1.3	2.15	0.8
459.3	2.1	1.33	1.6
746.5	3.4	0.82	2.9
975.5	4.9	0.57	4.4
1156.1	6.2	0.45	5.7
1221.5	7.0	0.40	6.5

Table 2: Time duration to gain 6.5 V at constant rpm

Time (min)	Dynamo Rpm	Voltage	Current (amp)
1	1221.5	3.7	0.96
5	**1221.5**	4.5	0.57
10	**1221.5**	5.9	0.43
15	1221.5	6.5	0.40
20	1221.5	6.5	0.40

Again from Table 2 it is seen that time required to achieve the highest voltage when the rpm of the dynamo is maximum. Approximately 15 minutes is required to achieve 6.5V when rpm is maximum.

Table 3: Time duration to charge the mobile

Time (min)	Voltage(V)	Current(amp)
1	6.5	0.40
4	5.9	0.34
6	4.3	0.30
10	3.6	0.23

Finally we have calculated the time required to charge the mobile. It is observed from Table 3 that after 10 minute the voltage drops so if we pedal during this time then 15 minutes is required to charge the mobile.

5.2 Discussion:

From the above experiment it has been shown that if the rpm range is increased then the mobile can be charged in the shortest possible time. If anyone wants to charge the battery at maximum rpm then at least 15 minutes is required to gain 6.5V. Again we have observed that after 10 minutes during the charge of the mobile voltage drops at an amount of 3.6V. By pedaling this voltage can be increased and the mobile can be charged within 15 minutes.

6. CONCLUSION

From the above discussion it can be concluded that

- By this system we can produce about 7 volt and 0.4 amp corresponding to the pedal about 1221.5 rpm.
- This power is stored in a 6 volt lead acid battery. At least one mobile can be charged by this battery when the cycle in not running.
- The mobile can be charged when the cycle is in static position as well as in motion.

7. REFERENCES

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