

# Optimum Utilization of a Bicycle

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**Abstract-** In 21<sup>st</sup> century the world is going towards a new era of invention. Every rising day comes with new invention or discovery. But all this is for what? Just to enhance the life of human being and to improve the living standard of human. The basic thought behind all this is that everyone is working for getting more and more comfort in this life. Now a day, our country and human life is mostly affected by load shedding. This is all from the shortage of electricity due to break down of power plant several times. So the production of electricity is affected. Therefore it is not possible to supply electricity as per requirement. It has badly affected the daily human life. Thus taking this point of view a human power generator should be designed that can work according to the human comfort requirement. Different type of generator is available in market, but they are not economical for common people. By keeping this point, the human power generator is useful for production or generation of electricity to fulfill our preliminary requirement of electricity in daily life by use of dynamo and solar panel for its use in stationary and mobile condition.

**Keywords – :** Dynamo, Generator, Solar cell, Electricity & Human Power Generator

## I. INTRODUCTION

Human invented most of the things for his comfort and convenience. Electricity is one of them. Now days, the production of electricity more hydraulic power plant, thermal power plant, wind power plant etc are constructed. In the hydraulic power plant the kinetic energy of water is used to run turbine and convert into mechanical energy and again into electrical energy by connecting generator. In the thermal power plant, the kinetic energy of pressurized steam is used to rotate the turbine and generate electricity. In wind power plant, the kinetic energy of wind is converted into electricity. In the human power generator, it works on the principle of convert muscular or physical energy of human being into the electrical energy by means of applying pulley arrangement. The pulley arrangement converts the efforts which is applied by human being into the rotating motion which is used to generate electricity and this electricity will be used as a preliminary requirement of electricity and also use of solar energy by means of solar cell for generation of electricity for use in stationary and mobile condition and also use of AC appliances by use of inverter.

The dynamo in the bicycle uses rotating coils of wire and magnetic fields to convert mechanical rotation into a pulsing direct electric current through Faraday's law of induction. A dynamo machine consists of a stationary structure, called the stator, which provides a constant magnetic field, and a set of rotating windings called the armature which turn within that field. The motion of the wire within the magnetic field causes the field to push on the electrons in the metal, creating an electric current in the wire. On small machines the constant magnetic field may be provided by one or more permanent magnets; larger machines have the constant magnetic field provided by one or more electromagnets, which are usually called field coils. Thus by the above mechanism dynamo charges the battery.

Renewable energy is rapidly gaining importance as an energy resource as fossil fuel prices fluctuate. One of the most popular renewable energy sources is solar energy .More and more people are getting on the solar energy

bandwagon. Installing residential solar panels for our home can bring big financial benefits, especially in the form of permanently reduced energy bills. Solar energy is virtually inexhaustible. The total energy we receive from the sun far exceeds our energy demands. It is probably the most reliable form of energy available everywhere and to everyone, unlike other sources. With dwindling supplies of petroleum, gas and coal, tapping solar energy is a logical and necessary course of action.

Solar Power is a way of converting sunlight into a useful energy source. There are two ways of using solar energy; as heat and as electricity. Devices like solar water heaters, driers and solar cookers use the heat to produce hot water, to dry grains or to cook food respectively. This way of using solar energy is called solar thermal. On the other hand, solar panels use the light to produce electricity, which can then be used for a multitude of purposes.

The main advantages of solar energy are as follows

- One of the cleanest forms of energy
- Harmonious with nature
- Easy to install, operate and maintain
- Long life. Solar panels can last up to 20 years or more
- Modular design, hence easy to expand
- Ideal for remote areas, where electricity is not reliable.
- Safe to handle
- Freedom from grid, which is often unreliable especially in remote areas.

Many companies in the world are gradually promoting quality as the central customer value and regard it as a key concept of company strategy in order to achieve the competitive edge. Quality improvement decisions are viewed as the catalyst for substantial technological developments being made in the manufacturing sector. Quality Costs are a measure of the costs specifically associated with the achievement or non-achievement of product or service quality – including all product or service requirements established by the company and its contract with customers and society. Measuring and reporting the quality cost is the first step in a quality management program. Quality costs allow us to identify the soft targets to which improvement efforts can be applied..

## II. LITERATURE REVIEW

In 1817 Baron von Drais invented a walking machine that would help him get around the royal gardens faster: two same-size in-line wheels, the front one steerable, mounted in a frame which you straddled. The device was propelled by pushing your feet against the ground, thus rolling yourself and the device forward in a sort of gliding walk. The machine became known as the Draisienne or hobby horse

The next appearance of a two-wheeled riding machine was in 1865, when pedals were applied directly to the front wheel. This machine was known as the velocipede ("fast foot"), but was popularly known as the bone shaker, since it was also made entirely of wood, then later with metal tires, and the combination of these with the cobblestone roads of the day made for an extremely uncomfortable ride.

In 1870 the first all metal machine appeared. (Previous to this metallurgy was not advanced enough to provide metal which was strong enough to make small, light parts out of.) The pedals were still attached directly to the front wheel with no freewheeling mechanism. Solid rubber tires and the long spokes of the large front wheel provided a much smoother ride than its predecessor. The front wheels became larger and larger as makers realized that the larger the wheel, the farther you could travel with one rotation of the pedals.

Peddalling History has on display even the recent history of the bicycle in America that we are more familiar with: the "English 3-speed" of the '50s through the '70s, the 10-speed derailleur bikes which were popular in the '70s (the derailleur had been invented before the turn of the century and had been in more-or-less common use in Europe since), and of course the mountain bike of right now. There are also many oddball designs that never quite made it, including the Ingo.

1980-1991 A Los Angeles based company called Luz Co. produced 95% of the world's solar-based electricity. They were forced to shut their doors after investors withdrew from the project as the price of non-renewable fossil fuels declined and the future of state and federal incentives were not likely. The chairman of the board said it best: "The failure of the world's largest solar electric company was not due to technological or business judgment failures but

rather to failures of government regulatory bodies to recognize the economic and environmental benefits of solar thermal generating plants."

Solar energy history played a big part in the way society evolved and will continue to do so There is a renewed focus as more and more people see the advantages of solar energy and as it becomes more and more affordable.

Governments across the world offer financial assistance.

*Solar energy in the future*

- As the number of people longing for a cleaner environment grows, so does the solar industry.
- Solar cells are becoming increasingly cost-effective as more distributors enter the market and new technologies continue to offer more choice and new products.
- We might even see the end of the combustion age in our lifetime.
- Cars might soon be powered by new fuel cells that create electricity through chemical reaction.
- Screen-printed solar cells are expected to drive prices down even more.
- Roofing shingles are capturing the sun's rays and turning them into electricity
- Solar panels are being mounted to the sides of houses when roof space is not an option.
- Pools are being heated with solar energy for a fraction of the price of conventional heaters.

*In our design*

- Use of dynamo which on just moving the shaft by hand produces electricity.
- Use of inverter so that both AC and DC equipments can be used.
- Use of solar panel so that bicycle can be used in stationary condition.
- Use of dry cell battery for storing energy and weight consideration of bicycle
- Voltage limiting circuit for limiting fluctuating current of dynamo.
- Use of pulley arrangement so wearing of tyre does not take place and frictional developed is less.

*Mechanical components use for project*

- Dynamo-15V, 2Amp.
- Bicycle.
- Pulley.(large:15inches,small:3inches)
- Solar Panel-12V ,5W
- Round belt.

*Electrical components for project*

- Rectifier-15V, 5 Amp-AC TO DC (do not allow back voltage).
- Filter Circuit-15V, 5Amp.
- Charge Controller (LM317).
- Inverter-500 W.
- Battery-12V, 7.5 AH.
- Over Voltage Protection Circuit

*Dynamo*

*Table 1. Difference between dynamo bicycle and bicycle generator*

Dynamo bicycle	Bicycle generator
Fluctuating DC current.	Constant DC current.
Cannot be used to run AC equipments.	Can be used to run AC appliances.
It does not give backup.	It gives backup.
Cannot be used in stationary condition	Can be used in rest condition.

*Pulley*

A pulley is a wheel on an axle that is designed to support movement of a cable or belt along its circumference. Pulleys are used in a variety of ways to lift loads, apply forces, and to transmit power.

*Alternator*

It is the device by which mechanical energy is converted into electrical energy. It is D.C. generator for generating D.C. voltage at output.

*Rectifier circuit*

It is a device which converts A.C. voltage into D.C. voltage. Some A.C. harmonics produced by D.C. generator with pulsating modulation of waves which is not in regular modulation, so for getting regular modulation of waves, rectifier circuit is used

*Filter circuit*

At the output of rectifier, D.C. voltage is not in pure form some A.C. components are in there so for purification of it, Shunt capacitor filter circuit is used. Filter is a circuit which minimizes or removed the undesirable A.C. component of the rectifier output & allows only the D.C. component to reach at output.

*Charging circuit*

It is the circuit which is used for charging the discharged battery.

Voltage limiting circuit:-

It is also called as voltage regulator circuit. Here, for voltage regulation of output voltage LM-317, 3-pin regulator IC is used. Voltage regulator is the circuit which eliminates or reduced variations in the D.C. output voltage or rectifier and filter circuit are called Voltage Regulator.

*Battery*

It is the source of D.C. voltage. It is the device where we want to store the D.C. voltage or it gives the D.C. source whenever we want.

*Inverter*

We are using electronic inverter. The function of electronic inverter is to convert D.C. to A.C. In our project we are generating 15 volt D.C. supply to convert 15 volt D.C. to 230 volt A.C. with the help of electronic inverter unit.

The function of inverter is to take the 12 volt D.C. and switching the 12 volt D.C. and give the step-up transformer convert 12 volt switching supply to 230 volt A.C. supply. It is most common part of inverter.

*Round belts*

Round belts are a circular cross section belt designed to run in a pulley with a 60 degree V-groove. Round grooves are only suitable for idler pulleys that guide the belt, or when (soft) O-ring type belts are used.

*Solar cell*

Solar cells produce direct current electricity from sun light, which can be used to power equipment or to recharge a battery.

### III. WORKING OF PROJECT

*Working of dynamo*

Basic principle on which dynamo works is "Faraday's law of electromagnetic induction". According to this law if an object or material that conducts electricity passes through a magnetic field then an electric current will begin to flow through that material.

*Construction*

Fig. 1 shows single turn rectangular copper coil ABCD rotating about its own axis I magnetic field provided by either permanent magnet or electromagnets.

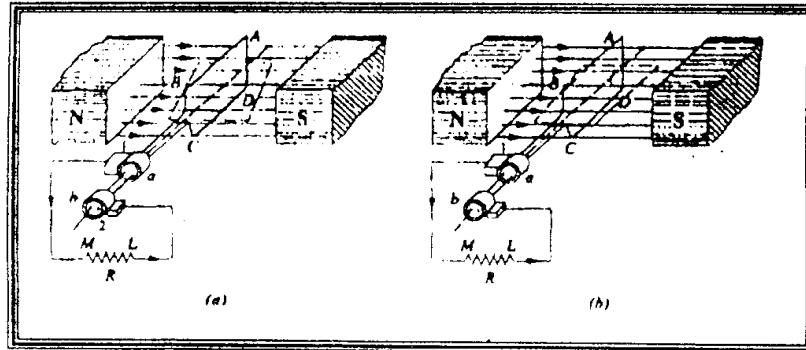


Figure 1: Rectangular copper coil

The two ends of coil are joined to two slip ring “a” & “b” which are insulated from each other and from central Shaft. The two collecting brushes (carbon or copper). Press against slip rings. Their function is to collect current induced in coil and to convey it to external load resistance R. The rotating coil may be called “armature” and the magnets are called as “field magnets”.

#### **Generator parts**

- Magnetic frame or Yoke
- Pole core or pole shoes
- Pole coils or Field coils
- Armature core
- Commutator
- Brushes & Bearings

#### *Yoke*

The output frame or yoke serves double purpose.

- It provides mechanical supports for the poles and act as a protecting cover for the machine and
- It carries the magnetic flux produced by poles. Yokes are made up of cast iron. But for large machine casting or rolled steel is employed.

#### *Poles cores*

The field magnets consist of cores & Pole shoes. The Poles shoes two purposes.

- They spread out the flux in the air gap and also being of larger cross-section; reduces the reluctance of the magnetic path.
- They support the exciting coils or field coils.

The complete poles cores & shoes are built of thin laminations of annealed steel. The thickness of lamination varies from 1mm to 0.25mm.

#### *Poles coils*

When current is passes through these coils, they electromagnetic the poles which produces the necessary flux that is cut by revolving armature conductors.

#### *Armature core*

It houses the armature conductors or coils and cases them to rotate and hence cut the magnetic flux of the field magnets. In addition to this, its most important function is to provide a path of very low reluctance to the flux through armature from a N-pole to a S-pole.

It is cylindrical or drum shaped and it is built up of usually circular sheet discs or laminations approximately 0.5 mm thick. A complete circular laminations made up of 4 or 6 or 7.8 segmental laminations. The purpose of using laminations is to reduce eddy current loss. Thinner the lamination greater is the resistance offered to the induced emf, smaller the current and hence lesser the  $I^2$  loss in the core.

*Working Principle*

Basic principle is “photoelectric effect”-Photovoltaic’s is the direct conversion of light into electricity at the atomic level. Some materials exhibit a property known as the photoelectric effect that causes them to absorb photons of light and release electrons. When these free electrons are captured, electric current results that can be used as electricity.

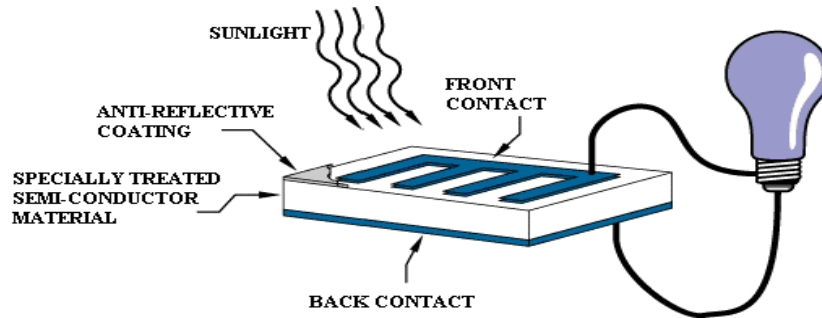


Figure 2: Photo electric effect

above block diagram shows charging of battery by solar panel. First solar panel absorbs solar energy and converts into electric current which is passed over charge controller to control fluctuations and then to the battery where it is stored as dc.

*Conversion of DC to AC*

After DC current is stored in battery by dynamo as well as solar panel it is converted into AC by use of inverter.

*Solar power charging mechanism*

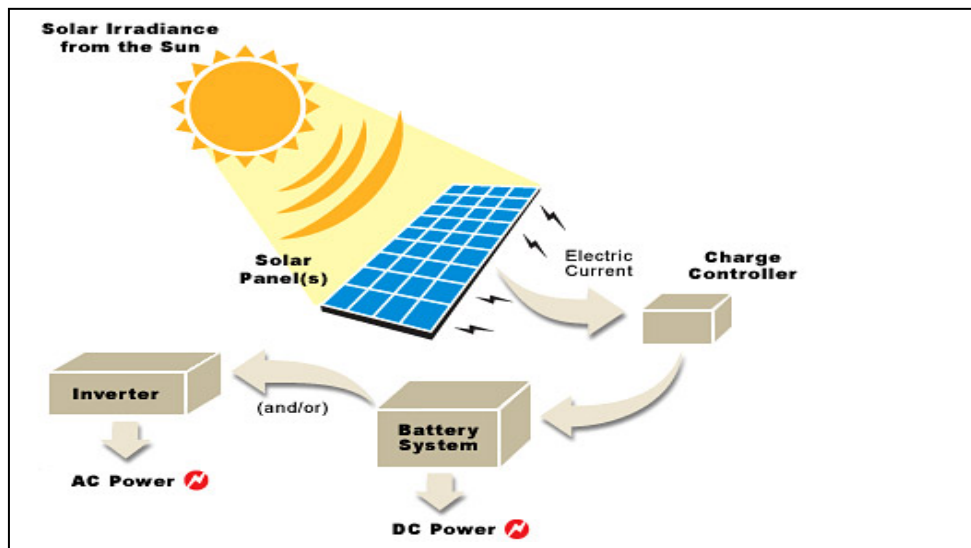


Figure 3: Solar power charging mechanism

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#### *Conversion of DC to AC*

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#### IV. CALCULATIONS

*A. IN ORDER TO INCREASE CURRENT GENERATION CAPACITY OF DYNAMO ITS SHAFT ROTATIONAL SPEED SHOULD BE INCREASED SO WE DO VELOCITY RATIO CALCULATION.*

Velocity ratio: - The ratio of the velocity given to the effort or input of a machine to the velocity acquired by the load or output.

Calculating velocity ratio of the two pulleys

According to formulae

$$V.R. = \frac{\text{Diameter of driven pulley (small)}}{\text{Diameter of driver pulley (large)}}$$

And according to unit conversion

$$1\text{ inch} = 25.4\text{ mm}$$

So,

$$\begin{aligned} \frac{\text{Diameter of driver pulley (large)}}{\text{Diameter of driven pulley (small)}} &= \frac{76.2}{381} \\ &= 1/5 = 1:5 \text{ (Velocity ratio)} \end{aligned}$$

So we increase speed of dynamo shaft by velocity ratio 1:5 that means if bigger pulley makes one rotation smaller pulley makes five rotations.

Calculating current generated

We are using 330  $\Omega$  resistors

Battery rating -12v, 7.5ah

We know,

$$\begin{aligned} i &= v/r \\ i &= 12/330 = .036 \text{ a} \end{aligned}$$

#### *B. Calculating power*

Battery rating-12v, 7.5ah

Ampere-hour

An Ampere-hour is a unit of electrical charge. A current source that delivers one amp-hour can deliver one amp for an hour or two amps for half an hour or sixty amps for one minute.

$$\begin{aligned} \text{Power (p)} &= V \times I \\ V &= 12\text{V} \quad \text{and} \quad I = 7.5 \text{ A} \\ P &= 12 \times 7.5 = 90\text{W} \end{aligned}$$

Considering 90% efficiency of battery, so power

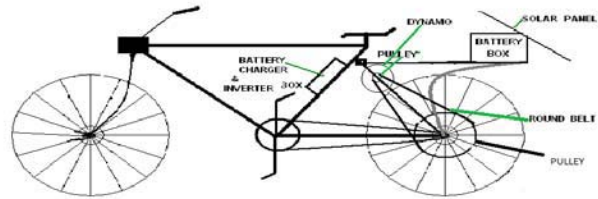
$$P = 0.90 \times 90 = 81\text{W}$$

Now we are inverting DC to AC using inverter so considering 80% efficiency of inverter so power developed

$$P = 0.80 \times 81 = 64.8 \text{ W}$$

So, we can light 6 CFL of 10W in 1 hour or 1 CFL of 10W for 6 hours.

## V. DESIGN OVERVIEW OF PROJECT



BICYCLE GENERATOR USING HUMAN AND SOLAR ENERGY AS FUEL

Figure 4: Project sketch

## VI. RESULT

- According to Faraday law of induction, the model works properly.
- The generation of voltage is varied with variation.
- We get constant supply of voltage by using battery and inverter section.
- We can use AC appliances by use of inverter.
- Solar panel is used for charging of battery in stationary condition.
- Pulley arrangement is used to minimize initial torque.
- Round belts are being used because of its high efficiency characteristic

## VII. CONCLUSION

We can use the muscular or physical energy of human being which is available at any time at any place by converting it into electrical energy by means of pulley arrangement to fulfill our preliminary requirement of electricity along with use of solar panel.

The Human Power Generator is primarily designed to charge a 12 volt, deep cycle battery or to contribute to a 12 volt system. It can also provide direct DC power.

The Human Power Generator will charge at a rate of between 3A to 5A when connected to a 12V battery. The average output is between 35 to 65 watts of power. AC appliances can be used with the Human Power Generator by using a DC-AC inverter connected to a battery. It is also possible to directly power certain DC powered equipment such as a low power water pump without using a battery. Appliances such as a DC television, light or radio may also be used. However, with this application, a voltage regulator may be required. The amount of electrical power that can be generated by the Human Power Generator is determined by the energy available to turn the crank. The stronger the user, the more electrical power can be produced. Typical output in watts with the Human Power Generator is about 60 Watts or 35 Watts with hand cranks.

We use solar panel in the cycle as it is renewable energy is rapidly gaining importance as an energy resource as fossil fuel prices fluctuate. One of the most popular renewable energy sources is solar energy. More and more people are getting on the solar energy bandwagon. Installing residential solar panels for our home can bring big financial benefits, especially in the form of permanently reduced energy bills. Solar energy is virtually inexhaustible. The total energy we receive from the sun far exceeds our energy demands. It is probably the most reliable form of energy available everywhere and to everyone, unlike other sources. With dwindling supplies of petroleum, gas and coal, tapping solar energy is a logical and necessary course of action



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