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Energy Harvesting from Gym Equipments

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Abstract: The world is facing energy crisis with the difference in demand and supply and limited number of natural resources. So there is a need for saving energy and requirement an alternate energy source which is cheap and feasible. This paper attempt to concentrate on how electrical energy can be generated from gym equipment/ exercise equipment. In urban areas people are very much health conscious and spend average one hours time in gym for his physical fitness. This project harnessed the mechanical energy of the machine and converted it to electrical energy using a generator-based system.

Keywords: Conversion, Gym equipment, Pully, Inverter, Battery, Energy.

I. INTRODUCTION

An energy crisis is any great bottleneck (or price rise) in the supply of energy resources to an economy. Energy crisis can develop due to Overconsumption,
Overpopulation, Delay in Commissioning of Power Plants, Wastage of Energy. Sometimes bottlenecks at oil refineries and port facilities restrict fuel supply [1]. An energy crisis can arise due to over use of the resources and wastage of energy generated. This project addresses both the issues of energy saving as well as energy generation using simple mechanism from gym equipment. "Energy changes from one form to the other". When people work out in gym then there are lot of energies involved in the process. Energy due to spinning of pulley, rolling/ up-down movement of exercise equipment, heat etc. are lost in the environment. The idea is to utilize and convert the mechanical energy to electrical energy. A mechanical shaft with the dynamo is attached to the pully of exercise equipment. When people workout on exercise equipment, pully rotates due to up-down movement of equipment, the pully rotates which in turn moves shaft of the dynamo. When the shaft rotates it generates the voltage based on Faraday"s law. This voltage can in turn be stored in a battery which can be further used to light the street bulbs.

The concept is "The average human generates around 100 watts in an average day. Depending on the person's activity, weight, and metabolism, a person's power can be slightly higher or lower. A typical American consumes about 2500 kilocalories of energy in a day. Assuming no weight gain or loss, this also means that 2500 kilocalories are used by the body in a day. With 2500 kilocalories of energy, the body is able to function properly. This allows you to do everyday activities such as reading, jogging, sleeping, etc"

1 calorie = 4.2 joules
2500 kilocalories = 1.05×10^7 J
1 day = 86400 s
P = W/t = 1.05×10^7 J/86400 s = 121.5 W

II. SYSTEM IMPLEMENTATION

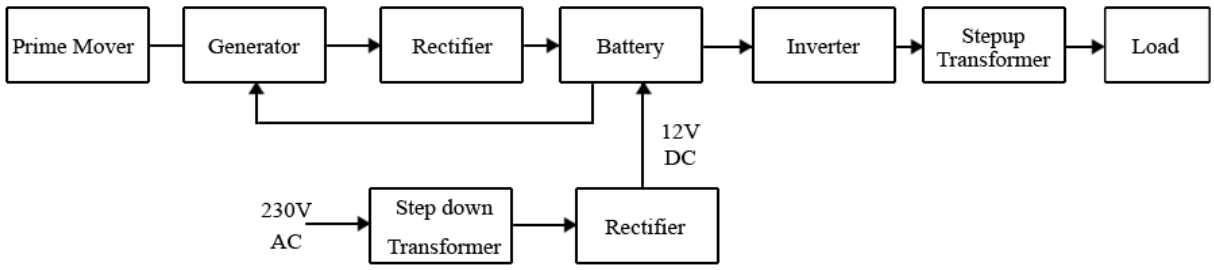

Fig.1 block Diagram of Energy Generation from

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III. MAJOR PARTS OF THE SYSTEM

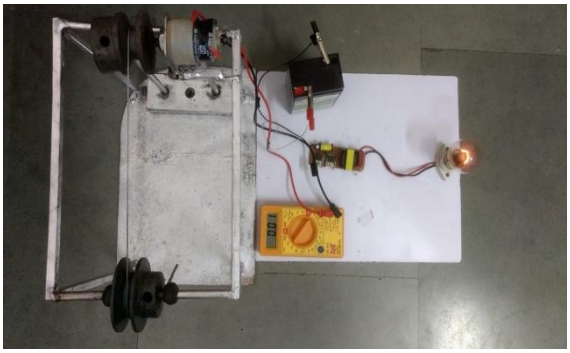

Fig. 2 Gym equipment with all accessories circuits

a. Prime Mover

All generators, large and small, ac and dc, require a source of mechanical power to turn their rotors. This source of mechanical energy is called a prime mover. Prime movers are divided into two classes for generators-high-speed and low-speed. Steam and gas turbines are high-speed prime movers, while internal-combustion engines, water, 19 and electric motors are considered low-speed prime movers. The type of prime mover plays an important part in the design of alternators since the speed at which the rotor is turned determines certain characteristics of alternator construction and operation.

b. Alternator

In this project dynamo works as generator.

The alternator is used to charge the battery and to power the electrical system when the exercise equipment pully spins. This seems to be the most reasonable motor for the design, as car alternators are widely available worldwide for relatively low costs when purchased as a used part.

An alternator is an electrical generator that converts mechanical energy to electrical energy in the form of alternating current. For reasons of cost and simplicity, most alternators use a rotating magnetic field with a stationary armature. Occasionally, a linear alternator or a rotating armature with a stationary magnetic field is used. In principle, any AC electrical generator can be called an alternator, but usually the term refers to small rotating machines driven by automotive and other internal combustion engines. An alternator that uses a permanent magnet for its magnetic field is called a magneto. The alternator consists of two main parts, rotor and the stator.

C. Voltage Regulator

A voltage regulator circuit for an alternator includes voltage responsive circuitry having a Zener diode. The regulator will maintain a pre-determined charging system voltage level. When the system voltage decreases the regulator strengthens the magnetic field and thereby increases the alternator output voltage. When the system voltage increases the regulator weakens the magnetic field and thereby decreases the alternator output voltage.

D. Rectifier

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 process is known as rectification. Physically, rectifiers take a number of forms, including vacuum tube diodes, mercury-arc valves, copper and selenium oxide rectifiers, semiconductor diodes, silicon-controlled rectifiers and other silicon-based semiconductor switches. Historically, even synchronous electromechanical switches and motors have been used.

Early radio receivers, called crystal radios, used a "cat's whisker" of fine wire pressing on a crystal of galena (lead sulphide) to serve as a point contact rectifier or "crystal detector".

Rectifiers have many uses, but are often found serving as components of DC power supplies and high-voltage direct current power transmission systems. Rectification may serve in roles other than to generate direct current for use as a source of power. Because of the alternating nature of the input AC sine wave, the process of rectification alone produces a DC current that, though unidirectional, consists of pulses of current. Many applications of rectifiers, such as power supplies for radio, television and computer equipment, require a steady constant DC current (as would be produced by a battery). In these applications, the output of the rectifier is smoothed by an electronic filter Rectifier circuits may be single the most common number of phase domestic equipment are single very important for industrial applications and for the transmission of energy as DC (HVDC RECTIFIER OUTPUT SMOOTHING Rectifiers are

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normally used in circuits that require a steady voltage to be supplied. To provide a steady DC output. The raw rectified DC requires a smoothing capacitor circuit to enable the rectified DC to be smoothed so that it can be used to power electronics circuits without large levels of voltage variation.

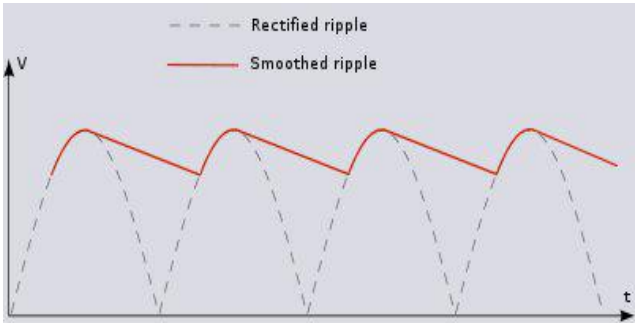

Fig-3 Rectified Output

E. Capacitor Bank

Capacitor stores energy in electric field. The stored energy is not maintained indefinitely, as the dielectric present between the plates allows for a certain amount of current leakage which results in the gradual dissipation of the stored energy.

Capacitor bank is an interconnection of such capacitors either in series or parallel based on requirement. Capacitors are electrical/electronic components which store electrical energy. Capacitors consist of two conductors that are separated by an insulating material or dielectric. When an electrical current is passed through the conductor pair, a static electric field develops in the dielectric which represents the stored energy. Unlike batteries, this stored energy is not maintained indefinitely, as the dielectric allows for a certain amount of current leakage which results in the gradual dissipation of the stored energy. A capacitor bank is a grouping of several identical capacitors inter-connected in parallel or in series with one another as required.

The demand for power is expressed in units of Kilo watt (kw) or Megawatt (Mw). This power is supplied by an electrical generating station. In alternating power system (AC), reactive power always comes in to picture. This reactive power is expressed in Kilo VAR or Mega VAR. The demand of this reactive power is mainly originated from inductive load connected to the system.

F. Diode Rectifier for Power Supply

The purpose of a power supply is to take electrical energy in one form and convert it into another. There are many types of power supply. Most are designed to convert high voltage AC mains elect suitable low voltage supply for electronic circuits and other devices such as computers, fax machines and Singapore, supply from 230V, 50Hz AC mains is converted into smooth DC using AC-DC power supply. A power into a series of blocks, each of which performs a particular function. A transformer first steps down high voltage AC to low voltage AC. A rectifier circuit is then used to convert AC to DC. This DC, however, contains ripples, which can be smoothened by a filter circuit. Power supplies can be 'regulated' or 'unregulated'. A regulated power supply maintains a constant DC output voltage through 'feedback action'. The output voltage of an unregulated supply, on the other hand, will not remain constant. It will vary depending on varying operating conditions, for example when the magnitude of input AC voltage changes. Main components of a regulated supply to convert 230V AC voltage to 12V DC are shown below.

G. Single Phase Full Wave Rectifier

In many power supply circuits, the bridge rectifier is used. The bridge rectifier produces almost double the output voltage as a full wave center-tapped transformer rectifier using the same secondary voltage. The advantage of using this circuit is that no center-tapped transformer is required.

During the positive half cycle, both D3 and D1 are forward biased. At the same time, both D2 and D4 are reverse biased. Note the direction of current flow through the load. During the negative half cycle (Fig 3.18) D2 and D4 are forward biased and D1 and D3 are reverse biased. Again, note that current through the load is in the same direction although the secondary winding polarity has reversed.

IV. RESULT

We construct innovative exercise equipment for generating electricity. By using gym equipment, Dynamo, capacitor bank, rectifier circuit and LED lamp. We successfully take the 12 V output supply and it is used to light 3v led and 5v

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cell phone charging. When the exercise machine is not used, the main supply is used to charge the capacitor bank. So, the capacitor bank also charges while the exercise machine is not in use. So, provide a continuous supply.

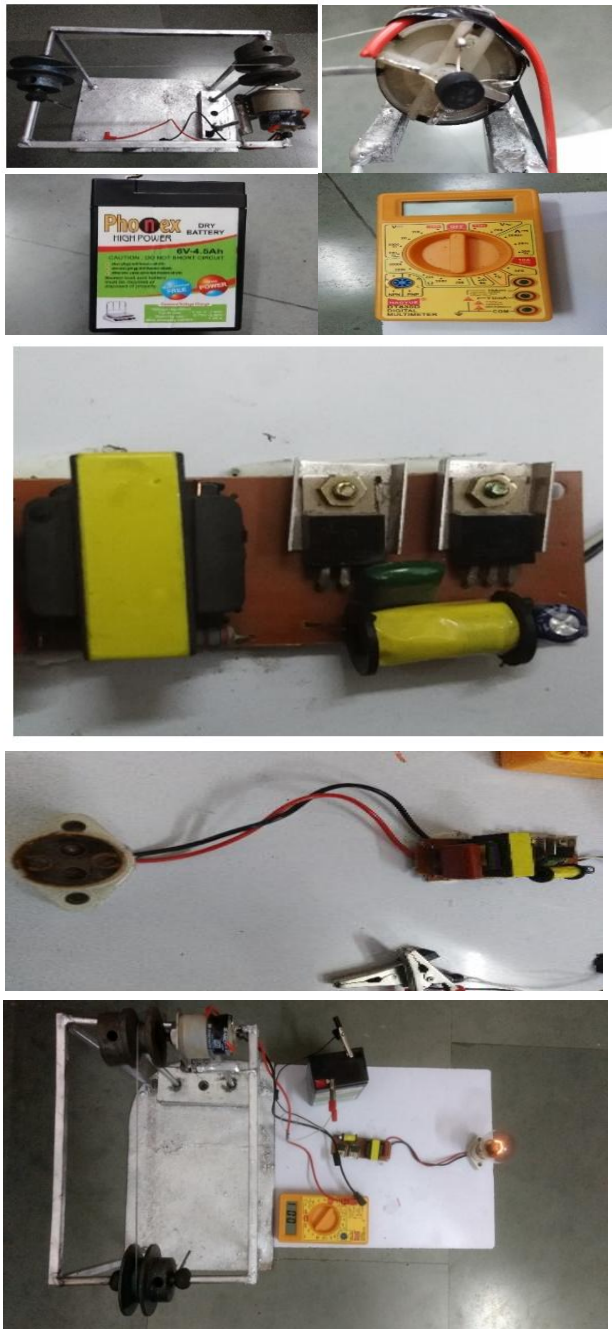

Fig. 4 Model of the System

Power Calculation

Average a man can produce a power of approx 100 watt in a day from a single exercise equipment.

1 day =100 watt

30 days = 30×100 watt = 3 Kilo Watt

With the amount of 3-Kilowatt power 03 Celling Fan can run approx 08 hours in a day for whole Month.

Appliance	Watts	No.	Hours	Watt x Hours	Units /day
Ceiling Fans	100	3	8	2400	2.40

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If the charge for electricity is □4/- per unit then the monthly electricity bill of 03 celling fan will be
2.4 × 30 = 72 unit/day &
72 × 4 = 288 Rupees
So, power generation by a single human on a single exercises machine is saving 288 rupees per month.

Still, might this be a reasonable way for a gym to offset at least some of its electricity use? Let's assume that the average piece of exercise equipment is in use 5 hours a day, 365 days a year. If each patron generates 100 watts while using it, that machine creates some 183 kilowatt-hours of electricity a year. Commercial power costs about 10 cents per kilowatt-hour on average in the United States, so the electricity produced in a year from one machine is worth about US $18 dollars (1100 rupees approx).

V. CONCLUSION

- This design and implement an innovative exercise equipment to generate electrical power for the house appliances.
- Energy storage is deemed necessary and important within renewable energy systems to ensure stability of the system. Coupling pedal driven generation and storage will drastically increase reliability of the smart system. These models vary in complexity and accuracy and therefore the model chosen must match the application for which it is needed.
- It will be very helpful for the rural areas. In this day where the world is challenged to be more responsible in its sourcing of electrical power, the method of human power generation could be a solution that also helps mitigate the issue of obesity and overweight.
- If additional design and study of this concept proves it effective in energy use reduction, localized energy delivery and sustainability education, it could efficiently answer the three great challenges; source of electrical power, reducing the emission of CO2 to the atmosphere and the issue of obesity.

VI. FUTURE SCOPE

- The energy generation from gym equipment can be also enhanced as now a day most of the population are health conscious and they are spending time for exercise in gym or another suitable place. If energy generation is large in amount then it can be also used for commercial purpose also.
- In future, if the flywheel speed control device and voltage protection devices can be added with large generation process, it would be a model all over the world.

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BIOGRAPHIES

Mr. Madhup Kumar is currently Pursuing AMIE (Institution of Engineers India) in Electronics and Telecommunication Engineering, Pune.

Prof (Dr.) G. S. Mundada is Professor (ECE) and Head T&P Cell at PICT, Pune. He is having teaching experience of 20 years; research of 5 years and the area of interest include Power Electronics, Wireless Networks, Application of Devices and Circuits. He is recipient of Best Teacher Award of Savitribai Phule Pune University during 2014_15.