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Power Generation through Gym Equipment

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Abstract: *Today among the scientific community the field of energy conservation has become an increasingly notable subject of research. Lat pull down machine aims at harnessing the mechanical energy of machine and converted into electrical energy using generator based system and to use it to power light bulbs, cell phone and other small appliances. Lat pull down machine usually consists of machine, chain, free wheel, fly wheel, gears, battery, dc generator, and inverter. The kinetic energy from the flywheel is supplied to the dc generator by means of gears. The generated power is stored in the lead acid battery. The part drawing of the various parts required for design of lat pull down machine are drawn and analysed by using solid works (2012). The result of the project shows that if all the machineries in the gym are equipped with suitable power generating equipment, more power can be stored in the battery.*

Keywords: *Energy conservation, Machine, Kinetic energy, Harnessing, Battery*

I. Introduction

There are basically two types of equipment in the fitness centre. They are free weights and machines.

Free weights

Free weights are the most basic form of body building equipment. The reason they are called "free weights" is because there are no attached pulleys, cables, pins, or weight stacks. They consist of barbells, dumbbells and weight plates.

Machines

The wide variety of exercises are performed in the machines. Some machines are designed to work individual muscles, while other machines consist of a multi-station that works the whole body. Most of the gyms have different machines for each muscle group. Machines are generally easier to use and safer than free weights.

1.1 Pull down machine

The Latin word latissimus meaning 'broadest' and dorsum meaning 'back'. They are commonly called "lats". The latissimus dorsi is responsible for extension, adduction and transverse extension also known as horizontal abduction, flexion from an extended position and internal rotation of the shoulder joint. During the lat pull down machine workouts, the muscles in the biceps and middle back get quite some attention. The pull down usually uses a weight machine with a seat and brace for thighs. The starting position involves sitting at the machine with the thighs braced, back straight and feet flat on the floor. During the full extension the arms are held overhead by grasping the bar connected to weight stack. The movement is initiated by pulling the elbows down and back, lowering the bar to the neck and completed by returning to initial position.

1.2 Leg press machine

The leg press is a weight training exercise in which the individual pushes a weight or resistance away from them using the legs. The term "leg press" also refers to the apparatus used to perform the exercise. The user sits below the sled and pushes it upward with their feet. These machines normally include adjustable safety brackets that prevent the user from being trapped under the weight. The leg press can be used to evaluate the athlete's overall lower body strength.

1.3Conceptual Model

Fig. 1 Conceptual Model

The part drawings that are used to manufacture the lat pull down machine are drawn by using the software solid works (2012). The conceptual model of lat pull down machine for power generation is shown in the below figure.

II. Methodology of Project

We will construct and manufacturing an entirely unique electric generation system that fuses both form and function into a cost-effective and convenient solution. Using a stationary puller machine to generate electricity and charge a 12 volt battery, we will obtain an output power of approximately 60 watts – plenty of power for lights, an amplifier, an iPod charger, and any unforeseen additional loads the student group may attach later. The system provides about 5 hours of fully-loaded use, and requires the equivalent for charging.

1. The system is comprised of several subsystems that will work collectively to efficiently produce the desired 50 to 150 watts of power.
2. The first subsystem is the mechanical connection which is will transfer the kinetic energy from pulling to the generator.
3. The second subsystem is the electrical generator. This subsystem transfers the rotational movement created when puller machine is in use to the rotor of a generator which will in turn output an AC voltage.
4. The third subsystem is the rectifier, which convert AC power to DC.
5. The fourth subsystem the battery and the battery charger. The Charge Controller adjusts the output to a single lead acid battery to optimize the use of the generated energy. This component will play a major factor in the efficiency of the system. The fifth subsystem is the inverter which convert the 12V DC to 12 V AC.
6. A sixth subsystem is the step up transformer which step up the 12V AC to 230V AC supply.
7. The seventh and final subsystem is the additional power supply for the battery when bicycle is not in use, which consists of single phase AC supply, rectifier and a step down transformer.

III. Elements of Proposed Design

3.1 Prime Mover
3.2 Generator (Alternator)
3.3 Rectifier
3.4 Inverter
3.5 Load
3.6 Battery
3.7 Battery Charger

3.1 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. 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.

3.2 Generator (Alternator)

An alternator is an electrical generator that converts mechanical energy to electrical energy in the form of alternating current. 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. The alternator consists of two main parts, rotor and the stator. Here the alternator is used to charge the battery and to power the electrical system when the pulling.

The last practical option to implement for the puller machine system was to use a standard car alternator.

Battery

Battery is essential to supply DC power for the alternator rotor and for the storage of generated power. An electric battery is a device consisting of one or more electrochemical cells that convert stored chemical energy into electrical energy. Each cell contains a positive terminal, or cathode, and a negative terminal, or anode, which allows current to flow out of the battery to perform work. Battery we used is 12V, 10 Ah rating.

3.3 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.

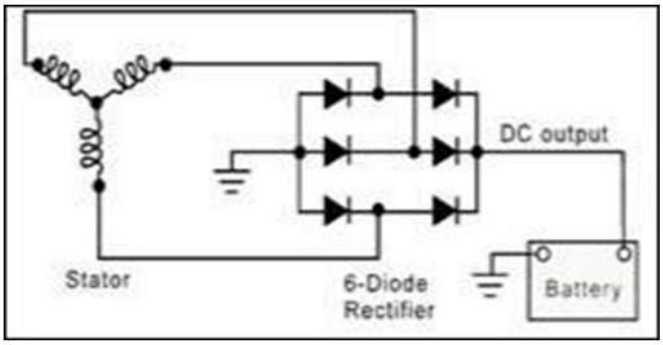

Fig. 2 Rectifier

Rectifier circuits may be single-phase or multi-phase. Most low power rectifiers for household equipment are single-phase, but three-phase rectification is very important for industrial applications and for the transmission of energy as DC.

3.4 Inverter

The inverter should be chosen so that its input voltage matches that of the storage battery. Suddenly, most inverters are designed to operate at about 12V in order to function with standard lead-acid batteries.
Inverter is a small circuit which will convert the direct current (DC) to alternating current (AC). The power of a battery is converted in to 'main voltages' or AC power.

This power can be used for electronic appliances like television, mobile phones, computer etc. the main function of the inverter is to convert DC to AC and step-up transformer is used to create main voltages from resulting AC.

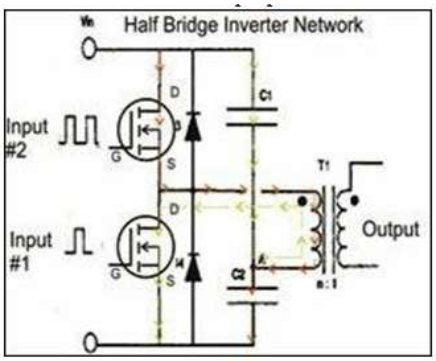

Fig. 3 Inverter

3.5 Load

Load is the generic term for something in the circuit that will draw power. Anything that uses electricity to do work will draw current. The amount depends on how much resistance to current flow the device has and the amount of voltage applied to it. Here we are using a 40W incandescent lamp as load.

3.6 Battery

An electric battery is a device consisting of one or more electrochemical cells with external connections provided to power electrical devices such as flashlights, smart phones, and electric cars. When a battery is supplying electric power, its positive terminal is the cathode and its negative terminal is the anode. Historically the term "battery" specifically referred to a device composed of multiple cells.

3.7 Battery Charger

A battery charger is a device used to put energy into a cell or (rechargeable) battery by forcing an electric current through it. Lead acid battery chargers typically have two tasks to accomplish. The first is to restore capacity, often as quickly as practical. The second is to maintain capacity by compensating for self-discharge.

IV. Analysis

The analysis of the machine structure and hand rod of the lat pull down machine by using solid works simulation are shown below.

4.1Analysis of machine structure

It is the rigid body which is used to support all the parts of the machine and to stabilize the overall weight of the machine. The structure is fixed at one end. The material chosen as A36 mild steel for the stability of the structure. The load is applied in one direction and its corresponding mesh details are to be given. Its corresponding displacement and vonmises stress are shown below:

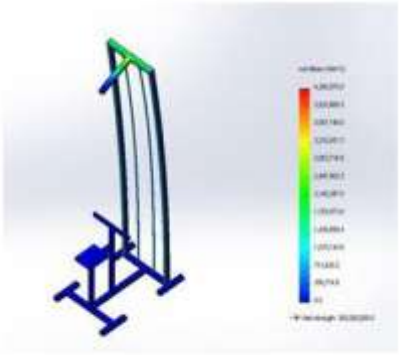

Fig. 4 Machine structure – Vonmises stress

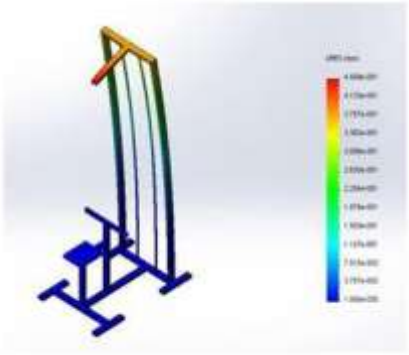

Fig. 5 Machine structure – Displacement

Thus the analysis of the machine structure for the applied load is done and the maximum deflection due to load is found as 0.450893mm.

4.2Analysis of hand rod

It is the solid bar which is made up of alloy steel. In the working stroke major force is concentrated on the top surface. Some hand rod are provided with rubber ball ends for safety and to protect user. Its corresponding displacement and vonmises stress are shown below:

Thus the analysis of the hand rod for the applied load is done and the maximum deflection due to load is found as 0.02355mm

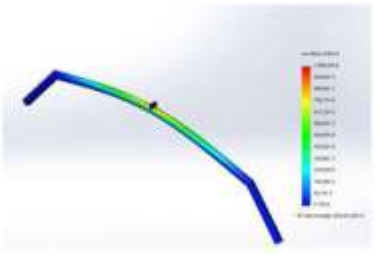

Fig. 6 Hand rod – Vonmises stress

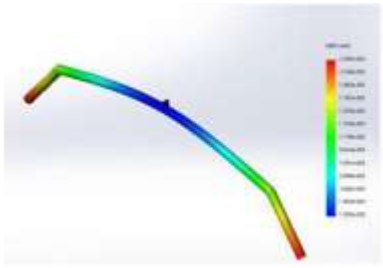

Fig.7 Hand rod – Displacement

V. Fabricated Model

Fig. 8 Lat pull down machine for power generation

Fig. 9 Lat pull down machine

VI. Results

The time the light takes to turn on is dependent on both speed and stroke length of the hand rod. Fig. 10 shows the relationship between speed and voltage. Fig. 11 shows the relationship between speed and current.

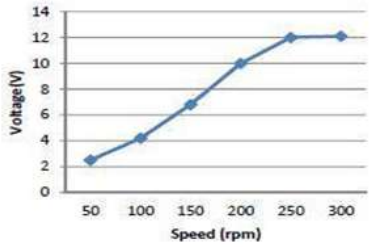

Fig. 10 Speed Vs Voltage

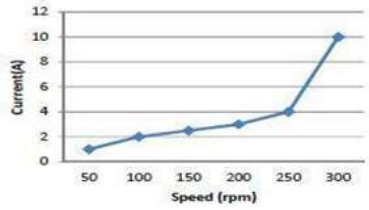

Fig. 11 Speed Vs Current

VII. Conclusion

We purpose and a put into effect innovative exercise equipment to generate electrical power for the house appliances. 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 sourcing of electrical power. If additional design and study of this concept proves it effective in energy use reduction, localized energy delivery and sustainability education, it could productive with effort.

VIII. Application

Power generation using gym pulling can be used most of places such As Colleges, School, Gym centre. It is use for plenty of power for lights, an amplifier, and an iPod charger.

IX. Advantages

- It is clean and eco-friendly energy. Low maintenance cost.
- It does not require any fossil fuel.
- It does not produce harmful effect on environment. Human health benefit.

X. Disadvantages

- Less amount of power generation nearly 30-40 W.
- Intermittent power generation.
- Mechanical moving parts are is more.

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