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"Fabrication and Experimental Study of Human Paddle Powered Mechanical Device for Battery Charging"

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Abstract—*In this paper authors fabricated, and experimentally studied the human paddle powered mechanical device for electric generation to charge the dc batteries for home lighting at rural areas where grid power is not available and population rely on kerosene for light. It has unique features of using human power as prime mover for electric generator. Human energy in form of high-torque low-speed can be converted into low-torque high-speed through speed increaser to energize the electric generator. The electricity generated is stored in the batteries of different capacity and used when required. This equipment is emission free, low cost and has long life. Also this equipment needs less maintenance and any person can run either skilled or unskilled.*

Keywords*: Muscle energy, human powered mechanical device, electric generation.*

1. INTRODUCTION

Over 1.5 billion people rely on kerosene for light. Lack of suitable home lighting is directly linked to illiteracy, poverty and health problems. The current widespread burning of kerosene also results in environmental pollution. It is very difficult and very costly to available grid power everywhere specially at remote isolated communities in developing countries. Although from beginning of mankind human have been doing for domestic works, but the electricity generation by muscle power is a novel technology.

Human power is a work or energy that is produced from the human body. It can also refer to the power (rate of work per time) of a human. Power comes primarily from muscles, but body heat is also used to do work like warming shelters, food, or other humans. A trained cyclist can produce about 400 watts of mechanical power for an hour or more, but adults of good average fitness average between 50 and 150 watts for an hour of vigorous exercise. A healthy well-fed laborer over the course of an 8-hour work shift can sustain an average output of about 75 watts. The yield of electric power is decreased by the efficiency of the human-powered generator [1-9]

2. FABFRICATION DETAILS

(i) Human Power: The authors' main object is to use the Human muscle power for generating electricity for domestic use. The two person of 55 kg and 73kg of age 22 year were worked alternate as an energy source.

(ii) Chain Drive: In this research work we used the Chain Drive system of Hero Cycle. A single strand chain number 8B is used in mechanical drive. The power rating is 0.64 KW at 100 rpm. The pitch dimension (p) of the chain is 12.70 mm. The driving sprocket has 54 teeth and rotates at 100 rpm. The driven sprocket has 17 teeth and rotates at 300 rpm.

Fig. 4.1: Chain drive of mechanical system.

(iii) Gears: Spur Gears are very useful in numerous applications. Not only can they transfer velocity and torque from one shaft to another, but, by using different size gears, they can alter the ratio between velocity and torque as they transfer them; a gear with many teeth driving a gear with fewer teeth will have less torque, but greater velocity and vice

versa. One set of spur gears transmit the power among parallel shafts. The spur gears are made of ductile cast iron. The spur gears have 68 teeth while the spur pinions has 18 teeth. The pressure angle is 20.

(iv) Speed increaser: Speed increaser has one set of chain drive and one set of spur gears housed in a frame of mild steel angles. It is having single number of stages with gear ratio of 1: 3.8. Input and output shaft of the speed increaser having 50 mm diameter and 600 mm length of mild steel material is in horizontal. One pulley of 18 inch is mounted on the side of the out-put shaft of gear system. The horizontal shafts are supported with roller bearings at the both ends.

Fig. 2: Human paddle powered Speed increaser.

(v) Belt and Pulley transmission unit: According to Indian Standard Code (IS: 2494-1974), the A type of belts are selected which has power ranges 0.7kW – 3.5 KW[10]. The first pulley of 9 inch is mounted on third shaft 50 mm above the fourth gear and drive the second pulley of 3 inch which is mounted on the fourth shaft at the same height. The third pulley of 18 inch is mounted on fourth shaft 50 mm above the second pulley which drive the another pulley of 3 inch mounted on alternator and alternator is fabricated on the frame

(vi) Generator: In this experimental study authors select the car alternator to generate electricity. Lucas-TVS car alternator of 12V and 40 AH is used. Car alternator needs high rpm to work efficiently. It produces constant voltage but current depends on rpm and produce high as rpm is high. The direction in which the alternator is oriented to spin does not affect its output power. The alternators rotor can be rotated either clockwise or counter clockwise and achieve the same output values.

Fig. 3: Belt-pulley, alternator and storage system.

(vii) Storage system: In this experiment a typical 12V, 40AH Lead-acid automotive battery is used. An automotive battery is a type of rechargeable battery that supplies electric energy to an automobile. Charging time depends on the capacity of that battery and the resting voltage of that battery when you begin to charge it.

3. FABRICATION AND PROCEDURE

The fabrication of speed increaser was done very carefully because there are three shafts which are supported by bearings. The bearing covers were fitted with the help of nut and bolt on the mild steel frame. Gears are fitted by means of nuts by drilling two holes on the shafts and on gear hubs. There is one step chain drive system, one step gear transmission system and one step pulley and belt transmission system. The two identical cycle paddles are framed and the first gear of 68 teeth is mounted on second shaft which mesh with the second gear having 18 teeth mounted on third shaft. The first pulley of 18 inch is mounted on end of third shaft which drives another pulley of 3 inch mounted on alternator and alternator is fabricated on the frame.

Author selects the car alternator for generating electricity. Car alternator starts to work about 1000 rpm. If human paddle the driving sprocket having 54 teeth with average 100 rpm then the driven sprocket having 18 teeth rotates with 100 * 3 rpm. Since gear of 68 teeth is fabricated in same shaft hence it also rotates at 100 * 3 rpm which rotates the second gear having 18 teeth with rpm of 100 * 3 * 3.78. The first pulley of 18 inch is mounted on same shaft; it has the same speed of 1000 * 3 * 3.78 rpm. The counter pulley of 3 inch mounted on car alternator thereby stepping up the speed in the ratio 1:6; hence the car alternator rotates at 100 * 3 * 3.78 * 6 rpm [10, 11].

100*3*3.78*6 = 6000 rpm [max]

Fig. 2: Human paddle powered mechanical device for electricity generation.

The system is tested by means of human power for many times. Before staring the experiment the alternator is connected with battery and ampere meter is jointed in series. When human applied force through paddle the driving sprocket starts rotate and drives the second sprocket as well as pulley one. The pulley one transmits power to counter pulley. At the starting the rpm is very low hence the alternator was not responding but as well as speed is increasing the alternator start to generating power. Human were need to applied force to maintain average speed. The rpm and generated volt & current were taken after every minute.

4. RESULT AND DISCUSSION

The humans' effort and speed depend on the load subjected. Experimental result shows that human take very little time to get working speed of 1000 rpm. Alternator generates constant voltage of 12V as specified after reaching ideal speed. The readings are taken after every minute. Speed vs. Current shows that at low rpm at starting motion it is not generating current by alternator, but as well as rpm is increasing and reaches to ideal working rang alternators producing high value of currents. The force applied by human muscle is varying so that the alternator rpm is also changing time to time and generated current also changing time to time.

The average rpm of human muscle power system is 2200 rpm and average generated current is 12AH. The experiment had done 9 times.

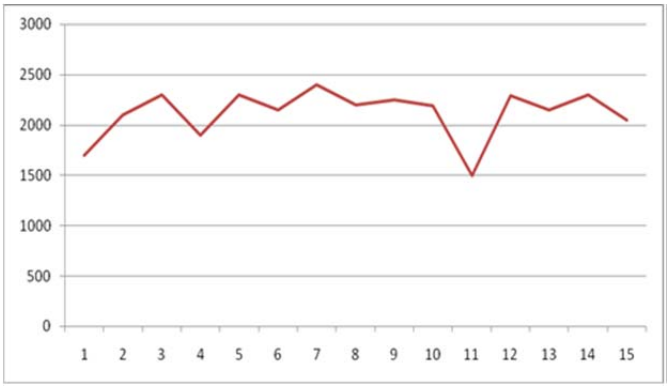

Fig. 3: Time (in minutes) vs. RPM of alternator.

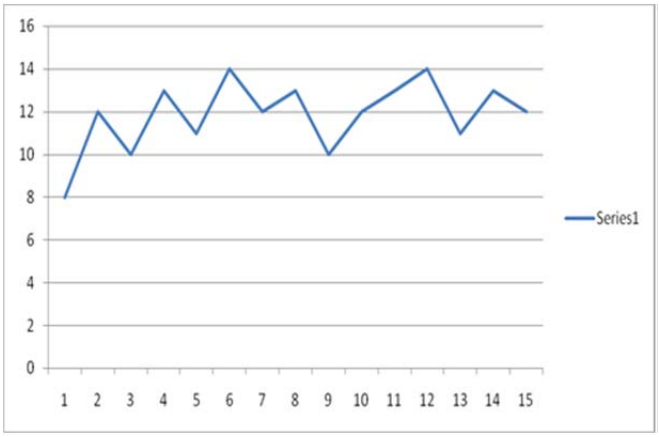

Fig. 4: Time (in minutes) vs. Current in AH.

5. CONCLUSION

The present work provides a mechanical device for producing electricity for home lighting using the biological energy of the muscles of human. The project goal was to design, fabricate and experimentally studied of mechanical device to charge a battery with a 12 volt DC output for 1.5 billion people who rely on kerosene for light. This goal had to be met within the constraints of a low production cost and high safety. The project has to offer a durable product with relatively good efficiency. This is also concluded that fabricated mechanical device is itself a very small scale industry for charging batteries at rural and isolated areas.

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