

Performance Analysis of Pedal Powered Multipurpose Machine

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Abstract

Energy is the most vital aspect in the development of modern technological civilization. The conventional energy sources are being scarce, so alternative energy sources are found which must be cheap, easily available and must satisfy the technical requirements. In the present work, a human powered multipurpose machine is developed which lifts water to a height 10 meter and generates 14 Volt, 4 ampere of electricity in most effective way. Power required for pedalling is well below the capacity of an average healthy human being. The system is also useful for the work out purpose because pedalling will act as a health exercise and also doing a useful work.

1. Introduction

Energy is the indivisible part of our living, with the even increasing the cost and decreasing sources of conventional energy like fossil fuels, finding the alternative non conventional energy sources is the need of present time. Apart of other renewable energy resources human power is one of the effective and alternative resources available since ancient time. The human being delivered their energy from calorific contains of foods they eat. A person can generate four times more power (1/4 HP) by pedalling than by hand-cranking. At the rate of 1/4 HP, continuous pedalling can be done for only short periods, about 10 minutes. However, pedalling at half this power (1/8 HP) can be sustained for around 60 minutes but power capability can be depend upon age [1-2]. A healthy male can only reliably maintain the high-power range of around (250 watts and above of mechanical power). The relation of human pedal power produced with respect to time is presented in Table-1.

Age (Year)	Human power by Duration of effort(watt)					
	Time Duration					
	5 min	10 min	15 min	30 min	60 min	180 min
20	220	210	200	180	160	90
35	210	200	180	160	135	75
60	180	160	150	130	110	60

As a result of the brainstorming exercise, it was evident that the main use of pedal power one specific product was particularly useful: the bicycle. Many devices can be run directly with mechanical energy [3]. Considerable research has been carried out by different researchers on pedal powered machine. Devices that can be operated by pedal power are table saw, band saw, meat grinder, wood carver, water pump, thresher and winnowers, stone polisher, lathe, pottery wheels. Appliances such as juicers, grain mill, butter churn, washing machine, Blender, water lifter, battery charger, Drill Press, Hack saw, pedal power juicer, power charger, Refrigerator, washing machine, battery charger, can be run directly by pedal powered machine with great efficiency. It also support to small scale, self-sustainable and to help contribute to the conservation of the environment and health of the local economy.

Satisfying energy needs by method will be great way to improve human health in busy life. It is badly needed a better system which considered the ergonomic and psychological factors of operator and that should be multiple purpose that can used producing pumping water, generation of electricity as well as exercise of operator which will look after fitness of operator and it can protect and safeguard of operators own interest and concerns.

In present study, a Pedal Powered Multipurpose Machine i.e. '*modified exercise bicycle*' has been developed which comprises of pedal powered generator for generating electricity and pedal powered pump for lifting the water of desired quantity at desired height without used of electricity or any other power.

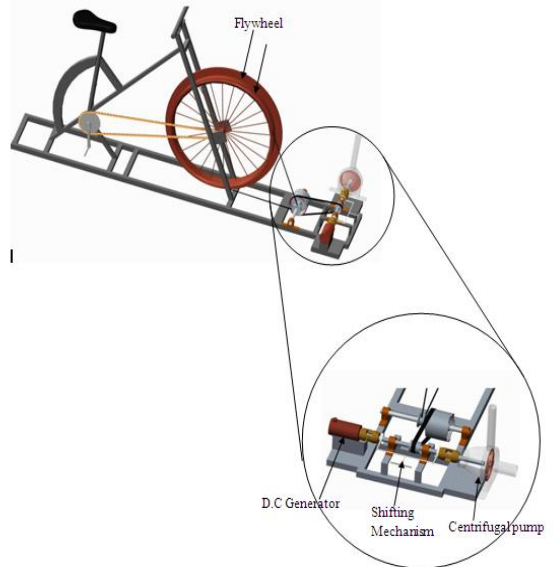
An attempt is made to make this multipurpose device low cost.

2. Methodology:

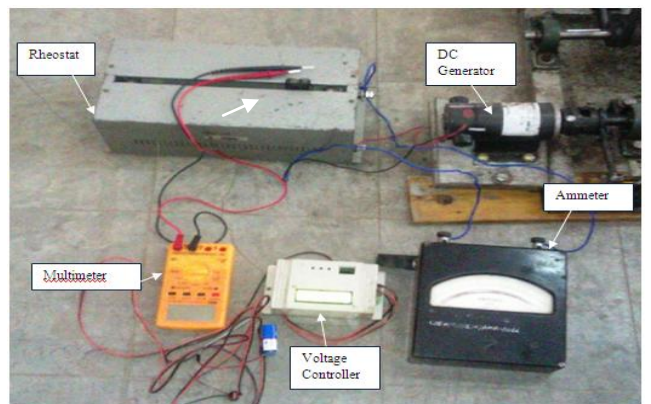
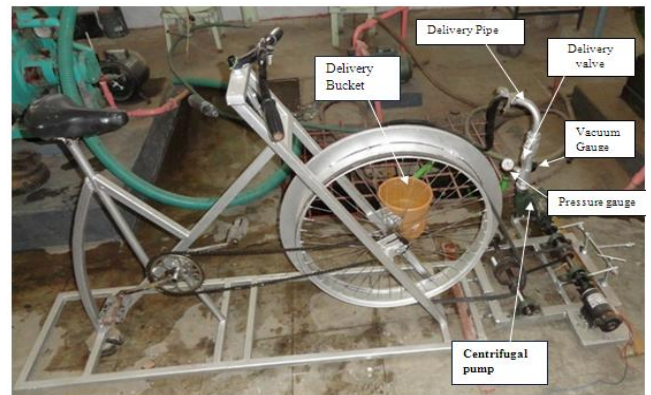
The multipurpose machine i.e. ‘*exercise bicycle*’ which was basically used for exercising purpose has been modified for water lifting and generation of electricity. The consideration for designing was to lift water to the height of 10 meter and to generate 14 volts, 4 ampere of electricity in most efficient way. Source of power utilized for above purpose is pedal power. Selecting ‘*exercise bicycle*’ for this application is due to its low cost, availability and design simplicity. Various types of pumps and generators are available in the market namely: Reciprocating, Rotary, Centrifugal Pumps and AC and DC generators respectively. In this scenario, Centrifugal pump and DC generator are selected as they are compact in size, simplicity in design, relatively low cost, light weight, and easy availability of spare parts.

3. Model development

The working principle of pedal operated multipurpose machine is based on flywheel driven belt and pulley system. The Peddler using his physical power for pedalling the flywheel rotates with the help of chain drive. The rotational motion of flywheel is transferred to the intermediate shaft and then to the main shaft and this power at main shaft is used drive either pump or generator with the help of shifting mechanism. When the main shaft rotates the impeller of centrifugal pump imparts energy to water because of which it can lift the water at high head. When the shifting mechanism so arrange that the main shaft engaged with rotor of the generator by using dog clutch mechanism. The CAD illustration design shown in figure 1.



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Sr No.	Parts	Quantity
1	Cycle frame	1
2	Centrifugal pump	1
3	DC Generator	1
5	Pressure Gauge	1
6	Vacuum gauge	1
7	Shifting Mechanism	1
8	Bearing	4
9	Flat pulley	2
10	Flat belt	1
11	V-Grove Pulley	1
12	V belt	1

Nevertheless, a working machine was ready for testing and performance as shown in figure 2; the measuring instrument was used for measuring delivery head, Discharge (flow rate) for different weight of operators. By adjusting the pressure gauge reading by delivery valve then record total head, delivery pressure, speed and discharge. Same procedure was followed for both male and female peddler. The Distinguished feature of this design is that once the pumping is finished power shaft is engaged by using shifting mechanism to the permanent magnet D.C Generator. Readings for current, voltage and generator speed were measured by using rheostat. Others sources of error included friction in the pipes, leaky couplings and human error in timing. But, however flawed the experiment may have been, it had proved that the pump and Generator worked. And it worked well. It had been shown that the pump could lift water and also the generator work satisfactory.

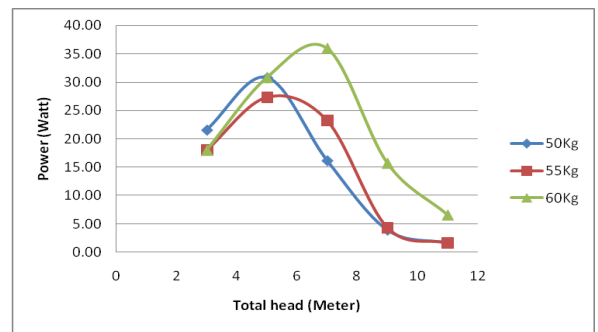
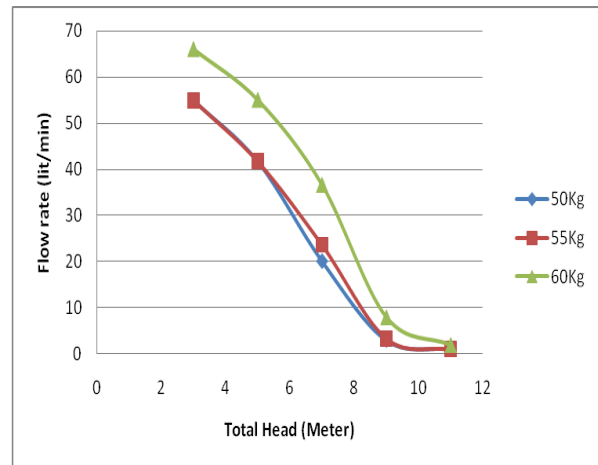
4. Result and discussion

Performance analysis for evaluating the multipurpose machine with various operators having different weight is done. The performance of pedal powered pump can be evaluated with the help of graph plotted against total head vs flow rate and power vs total head. Similarly for pedal powered generator the performance can be evaluated by using graph plotted against speed vs power, speed vs current and speed vs voltage.

4.1 For Pedal powered Pump:

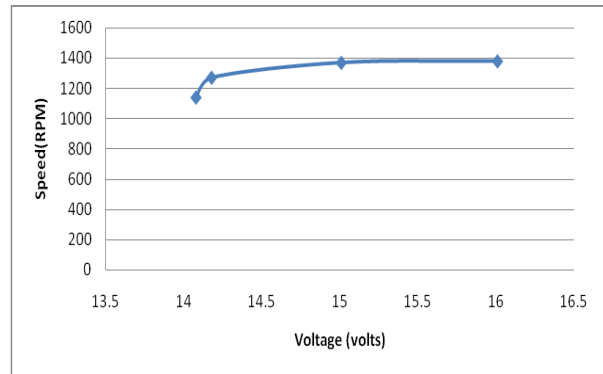
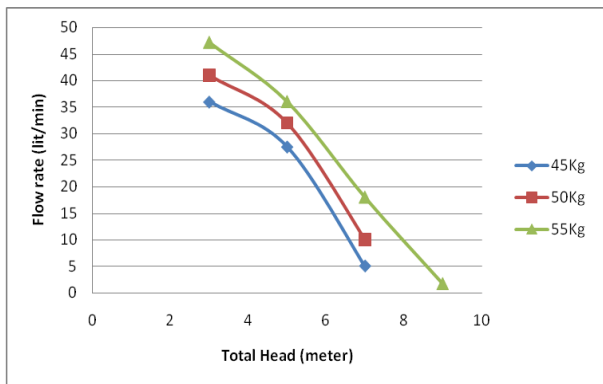
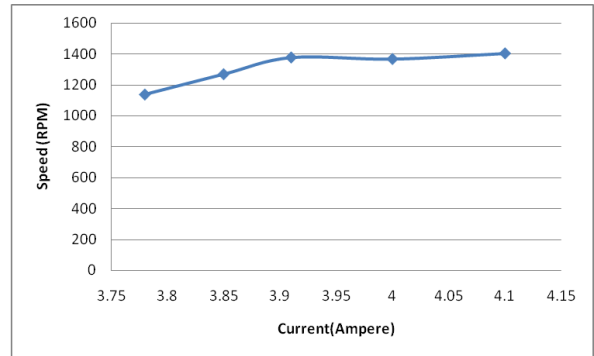
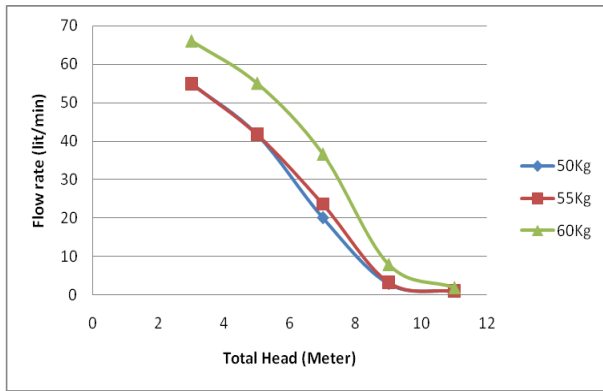
Figure 3, shows that maximum flow rate obtained was 66 lit/min corresponding pumping head is 3 meter for operator having weight 60kg and for same weight of operator, the maximum head is obtained 11

meter corresponding flow rate of 2 lit/min. similarly from figure 4, it is observed that power first increases and then decreases with the increasing total head and maximum power consumed is 25 Watt which is well within desired value, hence this system is suitable for desired application.



4.1.1 Comparison between male and female operators

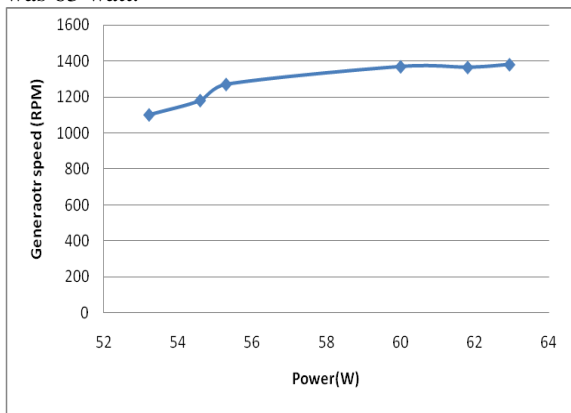
From Figure 5 it is seen that male peddler was able to pump to maximum testing head of 11 m with flow rate of 2 lit/min. However female peddler was less powerful and could reach 9 m with a flow rate of 5 lit/min. At the ground level, the male and female peddler kept the flow rate of water around 65 to 45 lit/min respectively. For domestic use, moderate pumping evaluation (5 meter) for the male and female operator achieved the flow rate of around 35 to 25 lit/min.



or

4.2 For Pedal powered Generator

From figure 6,7 and 8 it is observed that as the Speed increases power, current & voltage also increases. At maximum speed of 1400 rpm, current was 4.1 Ampere, Voltage was 16 V and power generated was 63 watt.



5. Conculsion

The working of human powered multipurpose machine is quite satisfactory for long duration of time. At the average head 6 m condition time required for filling a water tank of capacity of 1000 lit. is 33.33 min. Also the generator was working satisfactory by which we can charge a battery of 40 Ah within 10 hours, when fully discharged.

Power required for pedalling is well below the capacity of an average healthy human being. The system is also useful for the work out purpose because pedalling will act as a health exercise and also doing a useful work. Considering today's busy life this is going to be an important machine. This system was working properly satisfying the requirements of a user and this might be the future of devices used for pumping water and electricity i.e. for domestic and other purposes.

REFERENCES

[1] David Gordon Wilson "UNDERSTANDING PEDAL POWER" ISBN: 0-86619-268-9 [C] 1986, Volunteers in Technical Assistance" Technical paper 51 VITA 1600 Wilson Boulevard USA.

[2] EJ Yerxa Taylor & Francis “Occupational science: A new source of power for participants in occupational therapy”- Journal of Occupational Science ISSN 1442-7591 Volume: 13, Issue: 1, April 1993 pp254-259.

[3] Jon Leary “Putting Research into Practice: From a Steel City Drawing Board to the Heart of the Maya” The University of Sheffield-EWB-UK National Research Conference 2010,19th February 2010.

