

Experimental Investigation of Pedal Powered Centrifugal Pump

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Abstract :- The objective of this paper was to design, fabricate and experimentally investigate the working of Pedal Powered Centrifugal Pump (PPCP) which used in small drinking water supply and garden irrigation. PPCP consists of a centrifugal pump operated by pedal power. The centrifugal pump is positioned on its stand in such a way that driven shaft of the centrifugal pump is butted to the bicycle wheel. By pedaling the bicycle, the bicycle wheel rotates, thereby rotating the centrifugal pump which in turns discharges water from the sump. PPCP provides drinking water and irrigation in remote areas where electricity is not available. PPCP is not only free from pollution but also provide healthy exercise. PPCP reduces the rising energy costs. PPCP is designed as a portable one which can be used for irrigation in various places. The experimental investigation was executed and performance of the PPCP was carried out at different rpm. The results indicate that the PPCP had given a considerable amount of discharge and head. The PPWP requires only manual power thereby reducing the utility bill considerably. Experimental result shows that discharge of about $0.0025\text{m}^3/\text{sec}$ can be obtained for around 140rpm.

Keywords: - Pedal Powered Centrifugal Pump, Discharge

I. INTRODUCTION

Pedal Powered Centrifugal Pump (PPCP) is an eco friendly water pump. The PPCP works on mechanical energy without electricity. PPCP provides drinking water and irrigation in remote areas where electricity is not available. PPCP is not only free from pollution but also provide healthy exercise. PPCP reduces the rising energy costs. PPCP is designed as a portable one which can be used for irrigation in various places. PPCP consists of a centrifugal pump operated by pedal power. The centrifugal pump is positioned on its stand in such a way that driven shaft of the centrifugal pump is butted to the bicycle wheel. By pedaling the bicycle, the bicycle wheel rotates, thereby rotating the centrifugal pump which in turns discharges water from the sump.

The surveys of the literature regarding the PPCP are listed:

Atul.P.Ganorkar, K.S.Zakiuddin, H.A.Hussain [1] conducted an experiment on “Development of pedal operated water pump”. Their machine consists of three subsystems namely (1) Energy Unit : Comprising of a suitable peddling mechanism, speed rise gear pair and Flywheel conceptualized as Human Powered Flywheel Motor (HPFM) (2) Suitable torsionally flexible clutch and torque amplification gear pair and (3) a water pump unit. Though human capacity is 0.1hp continuous duty, the processes needing power even upto 6.0 hp can be energised by such a machine concept.

Vishal Garg, Neelesh Khandare, Gautam Yadav [2] conducted an experiment on “Pedal powered water pump”. They found pedal operated pump can be construct using local material and skill. This bicycle pedal operated pumps water at 2-3 gallons per minute from wells and boreholes up to 23 in feet depth. Provides irrigation and drinking water where electricity is not available. They can be built using locally available materials and can be easily adapted to suit the needs of local people. They free the user from rising energy costs, can be used anywhere, produce no pollution and provide healthy exercise.

Ademola Samuel Akinwonmi, Stephen Kwasi Adzimah, Fredrick Oppong [3] conducted an experiment on “Pedal powered centrifugal pump for pure water supply device”. This paper analyzes the design of a pedal powered purified water supply device to be used by local dwellers. It works on the principle of compression and

sudden release of a tube by creating negative pressure in the tube and this vacuum created draws water from the sump into the pump while rollers push the water through to the filter where adsorption takes place to purify the water. The design analysis shows that one revolution of the pedal gives 1.1 litres of water. This design will reduce the labour, cost and weariness caused by transporting and sanitizing drinkable water for use in the homes of Ghanaian villages.

Bryan Lee [4] has prepared a conceptually “Simple water pump” that will be easy to maintain and repair using basic tools while providing enough water flow to irrigate a small plot of farmland. The report outlines the design process that has been followed and a description of the agreed model that is to be constructed, cost analysis and timeline.

M.Serazul Islam, M.Zakaria Hossai and M.Abdul Khadir [5] conducted an experiment on “Design and development of pedal pump for low lift irrigation”. A study was undertaken to design and construct a low-lift pedal pump for use in small irrigation project areas. For this purpose, different types of piston valves and check valves were constructed and tested at different suction heads in the laboratory to evaluate their performances. During pedal pump operation, less input power was needed and it can be operated by one adult man for a long time (more than 2 hours) continuously without being tired. Efficiency of the pump was 46.53 percent against a head of 1.65 m. The pedal pump can be constructed using local materials and skill. It would be suitable to irrigate small and fragmented land holdings, especially to pump water from a shallow depth (up to 2 m) to irrigate small plots like vegetables and seed beds with less physical effort.

This study aims to design and fabricate a pedal powered centrifugal pump having a considerable amount of discharge and head and to investigate its functions experimentally.

II. EXPERIMENTAL SETUP

II.1. Experimental System

The PPCP consists of mainly three parts, the first one is centrifugal pump, the second is the bicycle, and the third one is the stand. PPCP consists of a centrifugal pump operated by pedal power. The centrifugal pump is positioned on its stand in such a way that driven shaft of the centrifugal pump is butted to the bicycle wheel. By pedaling the bicycle, the bicycle wheel rotates, thereby rotating the centrifugal pump which in turns discharges water from the sump. Figure 1. shows the pedal powered centrifugal pump. Pedal powered centrifugal pump specifications are given in Table1.



Figure 1: Pedal Powered Centrifugal Pump

Table 1: Pedal Powered Centrifugal Pump Specifications

Type	Manual Priming
Suction Diameter	3 inches
Delivery Diameter	3 inches
Total Head	32m
Suction Head	8m
Maximum Delivery Volume	1000 Litres/Minute

II.2. Experimental Procedure

The first step of making PPCP is the preparation of the stand. GI square pipes are made into sufficient pieces and are welded together to get the stand. The stand is then connected with the back wheel of the bicycle. By considering the wheel and rotor shaft space the centrifugal pump is connected with the stand by using the nut and bolts. The suction and delivery pipes are then connected to the suction and delivery ports respectively. Manual priming of the centrifugal pump is done next. By pedaling the Rpm of the rotor shaft is measured using tachometer. The flow rate of water is measured by using measuring tank and stop watch.

III. RESULTS AND DISCUSSIONS

Figure 2. gives the variation of discharge with rotor shaft rpm of PPCP. It is observed that the discharge increases uniformly with the rpm. Experimental result shows that discharge of about $0.0025\text{m}^3/\text{sec}$ can be obtained for around 140rpm. The variation in the obtained plot is due to errors in observation and due to power transmission losses.

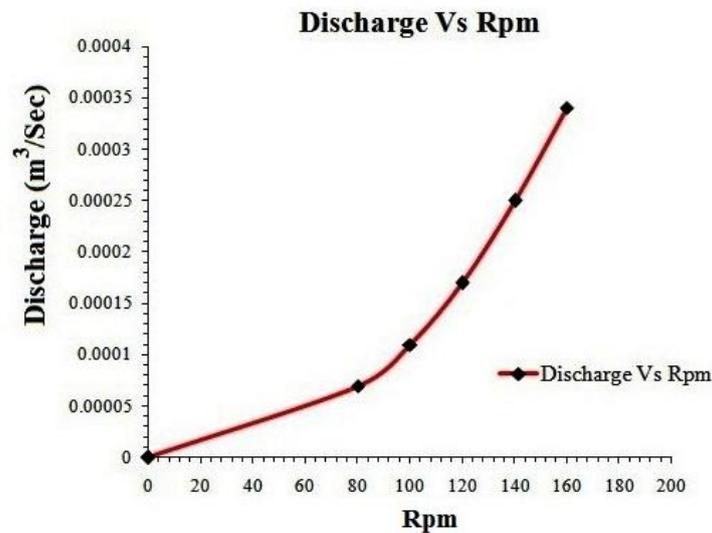


Figure 2: Variation of Discharge with Rpm

Figure 3. shows the variation of head with discharge of PPCP. It is observed that the head decreases uniformly with discharge. Experimental result shows that head of 8m can be obtained with discharge of about $0.00007\text{m}^3/\text{sec}$. The variation in the obtained plot is due to errors in observation and due to power transmission losses.

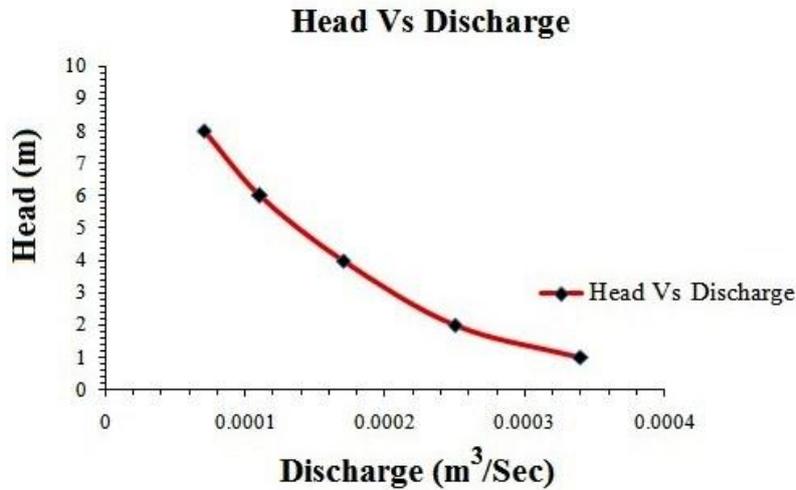


Figure 3: Variation of Head with Discharge

IV. CONCLUSIONS

The advantages of using PPCP were investigated experimentally. The main conclusions are listed as follows:

- 1) Pedal Powered Centrifugal Pump (PPCP) which used in small drinking water supply and garden irrigation.
- 2) Pedal powered centrifugal pump is cost effective. It is energy saving.
- 3) PPCP can be used in remote places where electricity is not available. It is designed as a portable one which can be used for irrigation in various places. It can be used as a standby unit.
- 4) Experimental result shows that discharge of about $0.0025\text{m}^3/\text{sec}$ can be obtained for around 140rpm.
- 5) Experimental result shows that head of 8m can be obtained with discharge of about $0.00007\text{m}^3/\text{sec}$.

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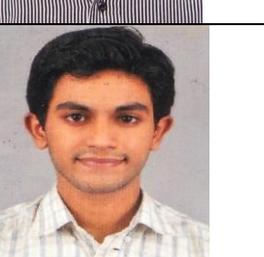
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