

Pedal Operated Water Pump

Chandrasekar Aswath¹, Manimohan Dhayananth², Moorthy Karthikeyan³,
Muthaiyan Ravikumar⁴

¹UG Student, Bannari Amman Institute of Technology, Sathyamangalam, Erode 638401 India

²UG Student, Bannari Amman Institute of Technology, Sathyamangalam, Erode 638401 India

³UG Student, Bannari Amman Institute of Technology, Sathyamangalam, Erode 638401 India

⁴Professor, Bannari Amman Institute of Technology, Sathyamangalam, Erode 638401 India

Abstract: The main objective of this project was to design, fabricate and experimentally investigate the working of Pedal Operated Water Pump (POWP) which used in small drinking water supply and garden irrigation. POWP consists of a pump operated by pedal power. The single acting pump is positioned on its stand in such a way that driven shaft of the pump is butted to the bicycle wheel. By pedalling the bicycle, the connecting rod moves forward and backward, thereby rotating the pump which in turns discharges water from the sump. POWP provides drinking water and irrigation in remote areas where electricity is not available. POWP is not only free from pollution but also provide healthy exercise. POWP reduces the rising energy costs. POWP is designed as a portable one which can be used for irrigation in various places. The experimental investigation was executed and performance of the POWP was carried out at different rpm. The results indicate that the POWP had given a considerable amount of discharge. The POWP requires only manual power thereby reducing the utility bill considerably. Experimental result shows that it is used to lift water up to 2 feet to 5 feet height by utilizing Mechanical Energy.

Keywords: Single acting pump, prototype model, Bicycle pedal, Outlet GI bend pipe, Connecting rod.

1. Introduction

The idea of pumping water has been in existence since the evolution of man. Pumping plays a very pivotal role in the day to day existence of mankind and as a result, different methods have evolved over the years to pump or displace water. Water supply has been a very critical issue, mostly affecting the rural areas. Water is one of nature's most important gifts to mankind. It is one of the most essential elements to good health and as such, it should be readily available to all and sundry. To address this problem, different methods and techniques have been used over the years ranging from man-powered operated ones down to the more efficient, but costly electrically and internal combustion engine powered pumps. This project seeks to design and fabricate a novel product that will be completely independent of any engine or electrical power source. This will be easily affordable and available to the rural dwellers and easily operated by all children and women inclusive. This will be easily transported from one place to another and can be easily set up without complication. Ease of manufacturing with available materials. Easily maintained and easily adapted for irrigation purpose, pumping of other liquids and mainly Cost effective.

2. Literature Review

Manisha.S. Lande et al., discussed that the human power is useful for production or generation of electricity to fulfill the requirement of electricity in daily life by use of dynamo and solar panel for its use in stationary and mobile condition [1]. It is also possible to directly power production by DC powered equipment such as a low power water pump without using a battery. Appliances such as a DC television, light or radio may also be used. Installing residential solar panels for home can bring big financial benefits, especially in the form of permanently reduced energy bills.

Sagar Vanjari et al., discussed that the Pedal Operated Water Pump (POWP) is designed and fabricated and used to lift water up to 20 feet to 30 feet height for lifting water from sump to water tank when there is no electric power supply or load shedding [2]. Centrifugal pump which is operated by pedal power to pump the water which is driven bicycle wheel and save the and produces no pollution. It can be used as a standby unit.

Remy Uche et al., detailed that a Dual Powered pump was designed and fabricated for water pumping by manually pedalling the system using the legs and by the use of dc motor [3]. It incorporated a manual gear assembly which disengages from the pump by means of a clutch when the pump is powered by the dc motor. The machine was tested and from the testing, it was shown that the machine can pump water from a height of up to 5metres and could discharge the water to a depth of up to 6meters; giving the machine a total

head of 10m at a flow rate of 14litres per minute during manual operation and 24litres per minute during operation with the dc motor.

Mogaji expressed that an improved pedal powered water pump machine was undertaken with the intention of providing a simple cost solution to the problem of delivery of ground water with relatively less effort [4]. This project analyzed the development of an improved pedal powered water pump for rural use. The system is composed of a reciprocating pump powered by pedalling via a chain drive. The results carried out showed that the pump discharge was 0.0016 m³/s at a head of 20m using a driving torque of 29.5 Nm with estimated efficiency of 90% which is fairly a good enough result for a pedal operated pumping system. It can be used for irrigation and drinking water purposes. It is more productive operated pumping system and is time saving.

Sreejith et al., investigated the working of Pedal Powered Centrifugal Pump (PPCP) which used in small drinking water supply and garden irrigation [5]. 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. 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 and reduces the rising energy costs. Experimental result shows that discharge of about 0.0025m³/sec can be obtained for around 140rpm.

3. Components used in 2-way cutting hand powered hacksaw machine

3.1 Single acting reciprocating pump:

An reciprocating pump is constructed of metal and has the following main parts.

1. Cylinder: This is a metal tube-shaped casing (or body), which is generally fitted with a metal lining called a 'cylinder liner. The liner is replaceable when it becomes worn and inefficient. The cylinder is also fitted with suction and discharge ports which contain special spring loaded valves to allow liquid to flow in one direction only - similar to check valves.

2. Piston: The piston consists of a metal drive rod connected to the piston head which is located inside the cylinder. The piston head is fitted with piston rings to give a seal against the cylinder lining and minimise internal leakage. The other end of the drive rod extends to the outside of the cylinder and is connected to the driver. Modern industries generally use high power electric motors, linkages and gearing to convert rotating motion into a reciprocating action. In a single acting pump, the backward stroke of the piston causes a suction which pulls in liquid through the inlet valve. (The same suction action keeps the discharge valve closed). On the forward stroke, the increase in pressure generated by the piston, closes the inlet valve and opens the discharge valve. The liquid is displaced into the discharge system. The flow from a reciprocating pump is uneven or pulsating. This can be undesirable in some applications. Flow can be smoothed out, but we will discuss this a little later. Like the rotary pumps, because the action is positive displacement, a piston pump can generate very high pressure and therefore **MUST NEVER** be operated against a closed discharge system valve unless it is fitted with a safety relief system in order to prevent damage to the pump and/or the driver and/or other downstream equipment.



Figure 1: Single acting reciprocating pump

3.2 Bicycle pedal setup:

The bicycle pedal is the part of a bicycle that the rider pushes with their foot to propel the bicycle. It provides the connection between the cyclist's foot or shoe and the crank allowing the leg to turn the bottom bracket spindle and propel the bicycle's wheels. Pedals usually consist of a spindle that threads into the end of the crank and a body, on which the foot rests or is attached, that is free to rotate on bearings with respect to the spindle. Pedals were initially attached to cranks connecting directly to the driven (usually front) wheel. The safety bicycle, as it is known today, came into being when the pedals were attached to a crank driving a sprocket that transmitted power to the driven wheel by means of a roller chain.

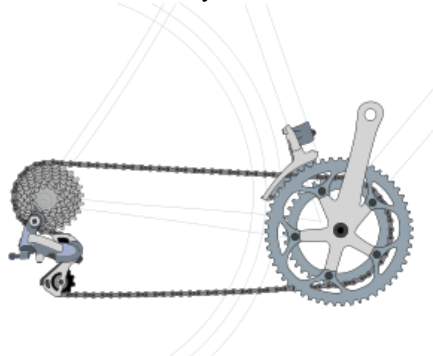


Figure 2: Bicycle pedal setup

3.3 Outlet GI bend pipe:

Pipe Elbow fittings is a very important pipe fitting. When we talk about a pipe elbow, it means a length of pipe with a sharp bend in it. Pipe elbows are fitting accessories which are used widely in various industrial sectors in pipe fitting. A pipe elbow is frequently used in pressurized applications and are available in various shapes and sizes for use in different application.



Figure 3: Outlet GI bend pipe

3.4 Circular Ball Bearing:

A ball bearing is a type of rolling-element bearing that uses balls made up of steels or alloys to maintain the separation between the bearing races as shown in Figure 4. The sole purpose of a ball bearing is to reduce rotational friction and support radial and axial loads of the rotating shafts. This is done by using by using at least two races to contain the balls and transmit the loads through the balls.



Figure 4: Circular Ball Bearings

4. Methodology

When human pedals, the mechanical energy are transferred to flywheel, here the mechanical energy is converted in to rotational energy. While pedaling the bicycle, the connecting rod which is connected to single acting piston of the cylindrical pump is forced to move forward and backward. This creates to and fro motion in the cylindrical pump. In the backward motion the pump creates the vaccum inside the cylinder and sucks the water from the sump or tank. Thus the water is pumped by utilizing the mechanical energy without electricity. In the forward motion the water is delivered out and water is passed to the irrigation purpose.As the rotation speed increases the section force is also increases thus the discharge of the water will be varied according to the rotational speed. Here the human creates the mechanical energy by pedaling the bicycle. The Diagram of Pedal Operated Water Pump is shown in Figure 5 and Figure 6.

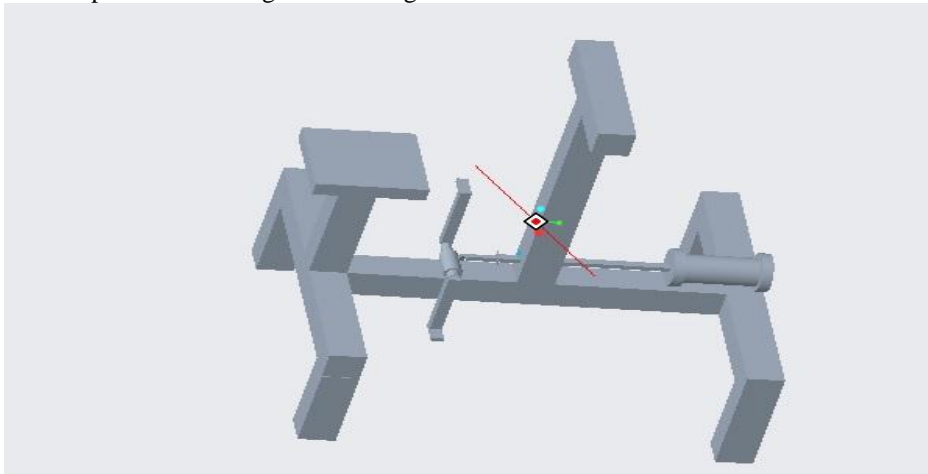


Figure 5: 3-D Diagram Pedal Operated Water Pump



Figure 6: Pedal Operated Water Pump

References

- [1] Manisha.S.Lande and Rupali.S.Tupkar “Optimum Utilization of a Bicycle” International Journal of Latest Trends in Engineering and Technology (IJLTET), Vol. 1 Issue 3, 2012, pp. 156-164.
- [2] Sagar Vanjari, Jayesh Mahajan, Amradeep Landge and Rahul Bajaj “Pedal Operated Water Pump” International Journal on Theoretical and Applied Research in Mechanical Engineering (IJTARME), Volume -6, Issue-1-2, 2017, pp. 175-178
- [3] Remy Uche, OnyewuchiOguoma and Eshiet Godfrey “Design and Fabrication of a Dual Power Water Pump” Innovative systems design and engineering, 2014, Vol.5, No.6, pp. 7-23.
- [4] Mogaji P. B. “Development of an improved pedal powered water pump”, International Journal of Scientific & Engineering Research, Volume 7, Issue 2, February-2016, pp. 1115-1124.
- [5] Sreejith K., Manu Sunny, Martin O.J., Mintu Louis, Noble Patrick K and Sonal P. Thomas, “Experimental Investigation of Pedal Powered Centrifugal Pump” , Research Inventy: International Journal of Engineering And Science, Vol.4, Issue 8 (August 2014), PP 56-60

Author Profile



Chandrasekar Aswath currently pursuing BE Mechanical Engineering at Bannari Amman Institute of Technology.



Manimohan Dhayananth currently pursuing BE Mechanical Engineering at Bannari Amman Institute of Technology.



Moorthy Karthikeyan currently pursuing BE Mechanical Engineering at Bannari Amman Institute of Technology.



Muthaiyan Ravikumar received the B.E. degree in Mechanical Engineering from Coimbatore Institute of Technology in 1996 and M.Tech degree in Energy Engineering from Regional Engineering College in 2000 and PhD degree in Mechanical Engineering from Anna University in 2012. Presently working as a professor, Mechanical Engineering Department, Bannari Amman Institute of Technology.