International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 08 Issue: 06 | June - 2024 SJIF Rating: 8.448 ISSN: 2582-3930

PEDAL OPERATED RECIPROCATION WATER PUMP

Mr. RAKESH BALKI[1], Mr. ANIKET SAWAIMUL[2], Mr. ANIKET DURAGE[3], Mr. PRASHANT DHOLE[4],Asst Prof. PRATIK P. CHAPHALE[5],Asst.Prof. AMAN DHANVIJAY[6], Asst Prof. VAIBHAV H. BANKAR[7]

chaphale.pratik@gmail.com , vhbankar@gmail.com

[1234]Student, Mechanical Engg. Department, VIT, Nagpur

[567]Asst. Professor, Mechanical Engg. Department, VIT, Nagpur

---

Abstract - A Water system includes a reciprocating pump operated by pedaling power. The pump set and includes a housing in which a foot pedal and drive shaft rotate an eccentric pin rotating with the drive shaft moves a connecting rod which in turn causes push rod to move linearly. The pushrod extends into a pressure tight chamber formed above the rising main. A pump connected to the push-rod extends to the conventional plunger through verified motion. Pumps are a common means of lifting water from a clean ground water source to a useful point of access, but all pumps have moving parts and are therefore destined to break proper selection of a pump will reduce undesirable downtime and will empower the local community to manage their water source. Here we use the foot pedal pump, powered by our legs instead of arms to lift the water from a depth range of seven meters. Throughout history human, energy has generally been applied through the use of the arms, hands, and back. With minor exceptions, it was only with the invention of the sliding-seat rowing shell, and particularly of the bicycle, that legs also began to be considered as a normal means of developing power from human muscles A person can generate four times more (1/4 horse power (hp)) by pedaling than by hand-cranking. At the rate of 1/4hp, continuous pedaling can be done for only short periods, about 10 minutes. However. pedaling at half this power (1/8 hp) can be sustained for around 60 minutes. The main use of pedal power today is still for bicycling at least in the high-power range (75 watts and above of mechanical power). In the lower-power range there are a number of useof pedal power for agriculture, construction, water pumping, and electrical generation that seem to be potentially advantages, at least when electrical or internal-combustion engine power is unavailable or very expensive. **Keywords:** pedal operated, reciprocation water pump

1. INTRODUCTION

Introducing the design and development of a 3-wheel handicapped steering propulsion cycle marks a significant milestone in the realm of inclusive mobility solutions. This innovative vehicle is not merely a means of transportation; it embodies a commitment to empowering individuals with disabilities to navigate the world with newfound freedom and independence. Let's delve into the unique features and thoughtful design considerations that define this pioneering project.There are lot of technological advancement, in wheel chair propulsion other than manual wheel turning. A normal wheel chair used for handicap and the tricycle users for normal people use hand drive or propulsion or foot pedal propulsion. The manual propulsion has become increasingly important because the population of propulsion of individuals using wheelchairs is growing and requires efficient mobility to maintain a quality of life equivalent to the general population. Several attempts have been made at improving manual wheel chair propulsion, such as changes in the wheels and tires, adding gears and designing alternative propulsion systems. Still, experts and consumers generally agree that innovation in propulsion is still needed. Improved propulsion technologies will reduce physical fatigue and effort maneuverability. Pain and upper extremity injury is common among manual wheel chair users. Shoulders related injuries have been shown to be present in up to 51% of manual wheel chair users. In addition, the prevalence of elbow, wrist and hand pain has been reported to be 16% . During wheel chair propulsion, users must exert large forces in order to propel the chair forward. In addition, the component of force that is directed in towards the hub does not contribute to forward motion but is necessary in order to provide friction between the hand and the push rim. There are two popular types of propulsion assist devices on the market today. One is a manual assist that uses gear rations to reduce the effort required to propel the vehicle and the other is a power assist that uses a battery powered motor to reduce the effort. Mechanical advantage is a measure of the force amplification achieved by using a tool, mechanical device or machine system. Ideally the device preserves the input power and simply trades off forces against movement to obtain a desired amplification in the output force. An ideal mechanism transmits power subtracting from it. This means that ideal mechanism does not include a power source, and is friction less and constructed from rigid bodies that do not deflect or wear.

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 everybody. 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 one. Water is a colorless, transparent, odorless, tasteless liquid that forms the seas, lakes, rivers and rain and is the basis of the fluids of living organism. Our ancestors built many of their villages and towns near springs and rivers so that they could get water easily. There is evidence around the world of early peoples using pipes and ditches for moving water to where people lived. They were also digging deep wells and making dams to collect and store water.

2. WATER DISTRIBUTION PUMP

Water-lifting devices fall into two main sub-categories depending on where the water is being lifted from. Groundwater - Rainfall seeps into the ground and collects in an underground reservoir. The upper limit of the reservoir is known as the water-table and can be just below the surface (as with a spring or oasis) or much deeper. The only way to get at this water is via a natural spring or to dig/drill down and use a water lifting device to bring the water to the surface. Water found on the surface of continents and islands is referred to as surface water. Surface water makes up only one fourth of one per cent, or 0.25%, of the total water found on Earth. This water is found in rivers, streams, lakes, springs and swamps, and is extremely important to the lives of all land dwellinganimals, including humans. Water from a lake, river or well may need to be transported to where it is required. Water-lifting devices can be used to make the water more accessible for purposes such as irrigation, drinking or bathing. The water then has to be taken to wherever it is needed - a time consuming and labour-intensive task. What they require is a device to transport the water so that it can be used for irrigation, bathing, drinking etc. Ideally there would be one machine that pumps the water up from the well and pressure rises sufficiently to reach everywhere it is needed. However, the vertical distances that the water will need to be pumped may exceed the limits of human performance. It is therefore concluded that bicycle powered water distribution pump will only be required to lift the water from the shallowest wells as its main function is to distribute the water across the surface.

3. OBJECTIVES

To design a pedal-operated reciprocation water pump that is efficient, cost-effective, and easy to use.
To analyze the mechanical and hydraulic performance of the pump.
To assess the impact of the pump on water access in target communities.

4. SCOPE OF THE STUDY

Design and fabrication of the pump.
Theoretical analysis of the pump's mechanics and hydraulics.
Field testing and performance evaluation.
Socio-economic impact assessment.

5. LITERATURE REVIEW

Literature survey: [1] Bryan Lee: the development of a human powered water pump for micro irrigation of rural farmland. Although there are manyhuman powered pumps currently available on the market, they are generally quite expensive and difficult to repair due to a lack of materials and machining tools. With the above in mind, design team 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.

[2] Atul P Ganorkar: the socio-economic conditions of peoples living in villages of developing countries including India, human muscle power can be good alternative to fulfill the energy requirements for performing many activities like water pumping. Pedaling is the most efficient way of utilizing power from human muscles. Keeping these things in mind a pedal operated water pump can be is developed.

[3] K S Zakiuddin: usually these devices are very laborious to operate and the operators suffer from various health hazards. Nobodycan work at much over 1/5th hp for very long time. According to the survey report, many users of these devices complain about their health problem like muscle pain, reduced body weight, weakness and fever. So the user demands to get a better technology, which requires less manual power and mechanical troubles. Hence to make the existing techniques more user-friendly and uncomplicated more intensive studies are required.

[4] Sreejith K,Manu Sunny: conducted the experiment on “Experimental Investigation of Pedal Powered Centrifugal Pump” their experiment consist of three parts – 1. Centrifugal pump 2. Bicycle, 3. Stand. Centrifugal pump is on stand such way that driven shaft is connected to bicycle wheel, bicycle (wheel) rotate so it rotates driven shaft of pump which discharge water from sump. Total head can be obtaining upto 8 m and discharge water 0.00007m3/s.

[5] Atul.Ganorkar, K.S.Zakiuddin, H.A.Hussain: conducted the experiment on “Development of Pedal Operated Water Pump” build a bicycle with a mechanism to convert mechanical energy created

during use and store for use. Build a device that will harmless and store this energy, and use that energy to offset current energy consumption. When there is cyclic speed fluctuation due to human power we have to use fly wheel. So we can reduce speed fluctuation. Flywheel stores energy so we need to pedal time after 1-2 minutes. Power is transmitted up to 95%.use of sprocket, gear ratio, can minimize torque and increase amount energygenerated. An average bike rider travels at speed of 12 mph. Thus speed can produce 1/10 hp. speeds of 18 mph can produce 1/4 hp. at a rate of 1/4 horse power, the human body can pedal continuously for 10 min, but at a rate of 1/8 horse power. continuous pedaling can last up to one hour.

[6] Arvind T. Wadgure, Ishan P: conducted the experiment on "Bi-cycle operated centrifugal pump mechanism for water lifting" it's found that by using bi-cycle operated centrifugal pump mechanism for water lifting we can reduce the human and electric power. These bi-cycle operated centrifugal pumps lift the water up to 15 in feet depth. As per the study over the topic that the bicycle powered water pump is a very advantageous especially for rural areas Paddling for few minute to pump water to a height of 30 feet.

[7] Mogaji P. B: conducted the experiment on Development of an Improved Pedal Powered Water Pump" The development of 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. The pump discharge was 0.0016 m 3 /s at a head of 20m using a driving torque of 29.5 Nm with estimated efficiency of 90%. It is used for irrigation and drinking water purposes. It is more productive operated pumping system and time saving.

6. METHODOLOGY

The following methodology was followed by the design of proposed project

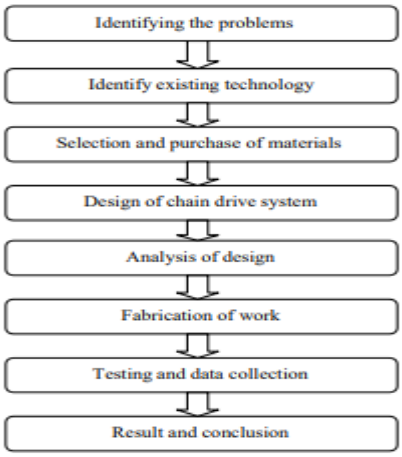


Fig 1: Methodology

7. COMPONENT DESCRIPTION

The design and implementation of a pedal-operated reciprocation water pump involve various critical components. This chapter provides a detailed description of each component, explaining its function, design considerations, and materials used.

1. Pedal Mechanism

Pedals

Function: The pedals provide the primary input force from the user, converting leg motion into mechanical energy.

Design Considerations:

Ergonomics: Pedals must be designed for comfortable use over extended periods.

Durability: Made from strong materials to withstand repeated use.

Materials: Typically constructed from steel or reinforced plastic for strength and durability.

2. Crankshaft

Function: Converts the rotary motion of the pedals into linear motion.

Design Considerations:

Length: The radius of the crank affects the torque and force transmission.

Robustness: Must handle the applied forces without deforming.

Materials: Generally made from high-strength steel or alloy for optimal performance.

3 . Linkage System

Connecting Rod

Function: Transfers the linear motion from the crankshaft to the piston.

Design Considerations:

Length and angle: Affects the smoothness of motion and mechanical advantage.

Material strength: Needs to be strong enough to handle repetitive stresses.

Materials: Typically constructed from steel or aluminum for a balance of strength and weight.

3. Lever Arm

Function: Provides mechanical advantage, reducing the effort required to pump water.

8. WORKING PRINCIPLE

Pedaling Action:

The user applies force to the pedals, which rotate the crankshaft.
The crankshaft's rotational motion is converted into reciprocating (back-and-forth) motion through the connecting rod.

Suction Stroke:

As the pedal is pushed and the crankshaft rotates, it moves the connecting rod, which pulls the piston upward in the cylinder.
The upward motion of the piston creates a vacuum (low-pressure area) in the cylinder.
The pressure difference causes the inlet valve to open, allowing water to flow into the cylinder from the source through the inlet pipe.

Discharge Stroke:

When the pedal motion reverses, the crankshaft moves the connecting rod to push the piston downward.
The downward motion of the piston increases the pressure inside the cylinder.
The increased pressure closes the inlet valve and opens the outlet valve.
Water is expelled from the cylinder through the outlet pipe and delivered to the spout.

Continuous Operation:
The user continues to pedal, maintaining the reciprocating motion of the piston.
This continuous motion ensures a steady cycle of suction and discharge, providing a consistent flow of water.

Illustration of the Working Cycle

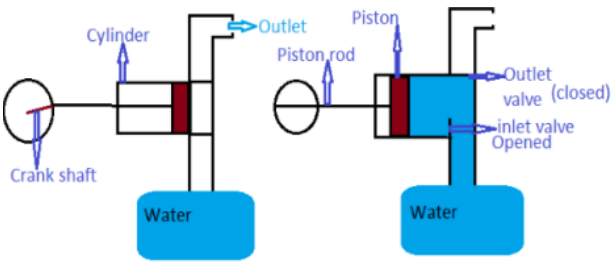
1. Starting Position:
Pedals are at rest.
Piston is at its lowest position.
Both inlet and outlet valves are closed.

2. First Half of the Cycle (Suction Stroke):

User starts pedaling, moving the piston upwards.
Inlet valve opens as the piston moves up, drawing water into the cylinder.
Outlet valve remains closed.

3. Second Half of the Cycle (Discharge Stroke):

Pedaling continues, moving the piston downwards.
Inlet valve closes, outlet valve opens.
Water is pushed out of the cylinder through the outlet pipe
.



9.APPLICATIONS

Rural and Remote Areas:

Ideal for regions lacking reliable access to electricity or fuel.

Can be used to irrigate small farms, provide drinking water, and support household needs.

Emergency and Disaster Relief:

Useful in providing immediate water access in disaster-stricken areas.

Portable and easy to deploy without the need for complex infrastructure.

Sustainable Water Solutions:

Promotes sustainable and environmentally friendly water pumping.

Reduces dependency on non-renewable energy sources.

10.ADVANTAGES

1. It is simple in construction and easy to use.

2. Cost is very low.

3. Can used wereelectricity not available or irregular.

4. Maintenance is low as parts are less and easily available.

5. Anyone can operate as simple in working and use.

6. A minimum of field transport.

7. Easy mounting.

8. Small team (minimum 2).

9. A surprisingly high speed as the water spurts from the drill pipe.

11.CONCLUSION

An appropriate technology meets a felt need, is simple to teach and understand, and uses resources poor people already have. By these criteria, the treadle pump is a good example of appropriate technology for small farmers. This study has shown that its current success can be explained in terms of tour factors: appropriate design, low cost, effective marketing, and high cash returns. The detailed design and careful selection of materials for each component of the pedal-operated reciprocation water pump are crucial for ensuring its efficiency, durability, and user-friendliness. This comprehensive understanding of each part's function and design considerations forms the foundation for building a reliable and effective water pump.

12.REFERENCES

[1]Atul.P.Ganorkar, K.S.Zakiuddin, H.A.Hussain, “An Experiment on Development of Pedal Operated Water Pump”, IOSR, e-ISSN:2278-1684,(2014).

[2]Vishal Garg, Neelesh Khandare, Gautam Yadav, “An Experimental Setup and Design of Pedal Powered Water Pump”, International Journal of Engineering Research and Technology (Vol.2, Issue.1)(2013).

[3]Ademola Samuel Akinwonmi, Stephen Kwasi Adzimah, Fredrick Oppong, “An Experiment on Pedal Powered CentrifugalPump for Purified Water Supply Device” ISDE (Vol.3, No.11) (2012).

[4]Bryan Lee, “A Design of Simple Human Powered Water Pump”, International Journal of Technology(2007).

[5]M.Serazul Islam, M.Zakaria Hossai and M.Abdul Khadir, “Design and Development of Pedal Pump for Low Lift Irrigation”,JARD, 5(1&2)116-126 (2007).

[6]R.S.Khurmi, J.K. Gupta: A textbook of machine Design(ed). Eurasia publishing House, new Delhi, India (2008). P 5098-51

[7] Aakash M.Bodh,G.H.Waghmare,” Study, Design And Improvement of Pumping System Efficiency Of Hydraulic PneumaticReciprocating Pump”, I met, Volume 7, Issue 5, September–October 2016.