Pedal Powered Water Pumping and Purification

Jayant Gidwani[1], Amit Kesheorey[2], Ratnesh Mishra[3], Rahul Lowanshi[4], Nitesh Lowanshi[5]
[1, 2, 3, 4, 5] Department of Mechanical Engineering
[1, 2, 3, 4, 5] Swami Vivekananda College Of Engineering Indore, Madhya Pradesh

Abstract- *This paper presents fabrication and experimentally investigate the working of Pedal Powered Water Pump (PPWP) along with its purification which had used for pure drinking water supply and garden irrigation. PPWP will consist 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 was 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. PPWP provides drinking water and irrigation in remote areas where electricity is not available. PPWP is not only free from pollution but also provide healthy exercise. PPWP reduces the rising energy costs. PPWP will design as a portable one which can be use for irrigation in various places. The experimental investigation was execute and performance of the PPWP had carried out at different rpm. The results indicate that the PPWP will give 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 0.0025m can be obtained for around 140rpm.*

Keywords- centrifugal pump, pedaling, pre-purifier, r.p.m.

I. INTRODUCTION

Pedal Powered Water Pump along with water purification(PPWPWP)is an eco friendly system. The PPWPWP works only on mechanical energy without electricity. PPWPWP provides drinking water and irrigation in remote areas where electricity is still a major problem .along with providing eco friendly environment it also helps to regulate a good health while pedaling PPWP is not only free from pollution but also provide healthy exercise. PPWPW Produces the rising energy costs. PPWPWP was designed as a portable one which can be used for irrigation in various places. PPWPWP 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 has 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 and transmitted to pre filter which purify the water simultaneously.

II. PROBLEM STATEMENT

a) Use of chain drives increasing human effort.
b) Centering of the axis of the driver to the driven causing whirling.
c) Effort getting waste to overcome the friction.

III. PROBLEM DEFINITION

To overcome the above said problems belt drive is used instead of chain drive which is utilizing maximum effort, previously which was going waste in overcoming friction. Also the whirling problem is resolved.

IV. PROPOSED METHODOLOGY

In this project we generally give mechanical power to the shaft, and the shaft is connected to pump which is mounted on bicycle.

The power generated by pedaling is transferred to the rear sprocket as is done in bicycle via chain drive. The rear sprocket is connected to pulley, which is connected to another pulley on the same shaft & axes. The power generated is being supplied to the rear sprocket then to the pulley connected, then to the second pulley connected mounted on the same shaft. The power by this shaft is transferred to the pump.

The inlet of the pump is connected to the surge tank via pipe. Outlet of the pump is connected to the water purifier for purification process.

With the help of this setup we can have a discharge to a certain head if required or we can purify water when needed.

V. WORKING PRINCIPLE

There are only three major principles on which our working model generally works:

1. Power transmission through chain drive mechanism.
2. Bernoulli's equation
3. Power transmission through pulley belt arrangement

Power Transmission through Chain Drive: Chain drive is a way of transmitting mechanical power from one place to another. It is often used to convey power to the wheels of a

vehicle, particularly bicycles and motorcycles. It is also used in a wide variety of machines besides vehicles. Most often, the power is conveyed by a roller chain, known as the drive chain or transmission chain, passing over a sprocket gear, with the teeth of the gear meshing with the holes in the links of the chain. The gear is turned, and this pulls the chain putting mechanical force into the system

Bernoulli's principle: In fluid dynamics, Bernoulli's principle states that an increase in the speed of a fluid occurs simultaneously with a decrease in pressure or a decrease in the fluid's potential energy. The principle is named after Daniel Bernoulli who published it in his book Hydrodynamica in 1738. Bernoulli's principle can be applied to various types of fluid flow, resulting in various forms of Bernoulli's equation; there are different forms of Bernoulli's equation for different types of flow. The simple form of Bernoulli's equation is valid for incompressible flows (e.g. most liquid flows and gases moving at low Mach number). More advanced forms may be applied to compressible flows at higher Mach numbers (see the derivations of the Bernoulli equation).

Power Transmission through pulley belt arrangement: Belts are the cheapest utility of power transmission between shafts that may not be axially aligned. Power transmission is achieved by specially designed pulley and belt. They run smoothly and with little noise, and cushion motor and bearings against load changes. This arrangement is made for power transmission and to reduce rpm as per requirements.

VI. WORKING OF THE MODEL

In working model of " pedal powered water pumping and purification" we are giving power to the shaft which is connected to the pump. The pump is then connected to the purifier which simultaneously purifying the water. Power which we are getting from pedaling is transmitted from front to rare sprocket through chain drive mechanism, the same rpm then transmitted to the pulley which is mounted on the same shaft. This pulley transmitted power to the main shaft via belt drive arrangement which is then connected to the pump. This pump's outlet is connected with the filter to purify the water.

Figure 1 Pedal Powered Water Pumping and Purification

VII. SPECIFICATION OF COMPONENTS

1.	Diameter of sprocket	.168m (driven)
2.	Diameter of sprocket	0.065m (driver)
3.	Center distance between driver and driven	0.48m
4.	No. of teeth of driver	45
5.	No. of teeth on driven	18

6.	Casing diameter	0.15
7.	Discharge diameter	0.02m
8.	Suction diameter	0.025m
9.	Datum height	0.9m
10.	Delivery head	1.03m
11.	Suction length	1.1m
12.	Delivery length	2m
13.	Rotating speed	430(N2) 130(N1) (with load) 680(N2) 150(N1) {no load}
14.	Total distance	0.86m
15.	Shaft to pump	0.77m
16.	Diameter of small pulley(1)	0.26m
17.	Diameter of small pulley (2)	0.12m
18.	Crank radius	0.18m

VIII. RESULTS AND DISCUSSION

1. Model calculation

$L_{1-} = \pi(r_1 + r_2) + 2x + (r_1 - r2)^2 / 48$
$= \pi (8.2 + 3.2) + 2 * 48 + (8.2-3.2)^2/48$
$L_1 = 1.32m$

2. Calculation of chain

Pitch of chain
P=AB = 2 AO sin (Θ/2) = 2* (D/2) sin (Θ/2)
D= diameter of the pitch circle
T= No. of teeth on the sprocket
So, P = D sin (360/2T)
P = 16.8 sin (360/2*45)
P = 1.171

3. Pitch circle diameter

D= p cosec (180 /T)
P = D sin (180/T)
D=1.171 cosec (180/45)
D= 16.8cm

4. Length of chain

L = K.P
K= no. of the chain links
P= pitch of chain

The no. of chain links –

$K = (T_1 + T_2/2) + (2x/P) + \{T_2 - T_1 / 2\pi\}^2 (P/x)$
$= (45 + 18/2) + (2*48/1.17) + \{18 - 45/2\pi\}^2 (1.171/48)$
$K = 1.13m$

Therefore,
L= K*P
= 113*1.171
L = 1.32 m

5. Discharge

Discharge = 5 liter in 6.2 sec
6.2 = 5/1000
$= 0.00080\ m^3/sec$
= 0.806 lit/sec

6. Velocity

Velocity = discharge/ area
$= .00080/(\pi * r^2)$
$= .00080/\pi (0.025/2)^2$

d= diameter of suction
D= diameter of casing
{v_2= 1.63 m/sec}

7. Calculation of coefficient of friction

$= 0.0008 + \{0.05525/(5652125.279)^{0.237}\}$
$\mu_1 = 0.0021$

8. Head loss due to friction

$H_2 = \mu_1 v^2 L/2gd$
$= .0021*3.1*(1.63)^2/ 2*9.81*0.025$
$= 0.035m$

9. Pressure

P_1= 0.08825 bar
P_2 = 0.29430bar

10. Velocity

$V = 1.04\ m^3/sec$
$V = 1.63 m^3/sec$

11. Torque

$\tau = 48.54$ Nm

12. Power delivered by pump

$= \rho g H_p \Theta$
$= 1000*9.81*1119*0.0008$
$P = 8781.9W$

XI. CONCLUSION

We know that electricity is still one of the major problem in rural area. In summer days people struggles with the shortage of water. pedal powered water pumping and purification meet these problem as this system only works on pedal powered there is no need of electricity neither to pump nor to purify the dirty water. of Pedal Powered Water Pump along with its purification which is used for pure drinking water supply and irrigation in remote areas. pedal powered water pumping and purification is not only free from pollution but also provide healthy exercise. pedal powered water pumping and purification reduces the rising energy costs. pedal powered water pumping and purification is design as a portable one which can be use for irrigation in various places. The experimental investigation was execute and performance of the pedal powered water pumping and purification had carried out at different rpm. So in this paper we have proposed that the pedal powered water pumping and purification will give a considerable amount of discharge and head.

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