International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 2 Issue 11, November - 2013

Development of a Mechanism to Run a Centrifugal Pump by a Bicycle

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Abstract

Development of a mechanism to run a centrifugal pump by a bicycle.

1. Introduction

This paper represents the development of a mechanism to run a centrifugal pump by bicycle.

The mechanism consists of single centrifugal pump which is fixed with the rear wheel bicycle. Paddling for just a minute for just a minute or two is enough to pump 30-40 litters of water to a height of 100 feet. Our project could prove helpful for rural areas. Which are facing load shedding problem? It can be used mainly for irrigation and water drawing water from wells and other water bodies.

This is a centrifugal water pump which is run by rotating the pedal of a cycle. The system comprises a bicycle, rim, impeller, pulley and inlet and delivery pipes. A wheel is connected to another pulley with a smaller diameter the final supporting shaft is connected with an impeller through this process of paddling is used to lift water from a pipe into the form for cultivation. This innovation is useful for pumping water from river, ponds, wells and similar water sources thus enabling poor farmers for pumping water for irrigation and cultivation.

We drive a bicycle by using a paddling the wheel of the bicycle rotates a particular rpm. And this wheel rotates the impellers of the centrifugal pump by rotary action between wheel and pulley but the rpm of the wheel is very low so we can't get require head and power effort on the paddling is low so we can use the pulley which is mounted on the shaft of the pump and create the high rpm by using less power.

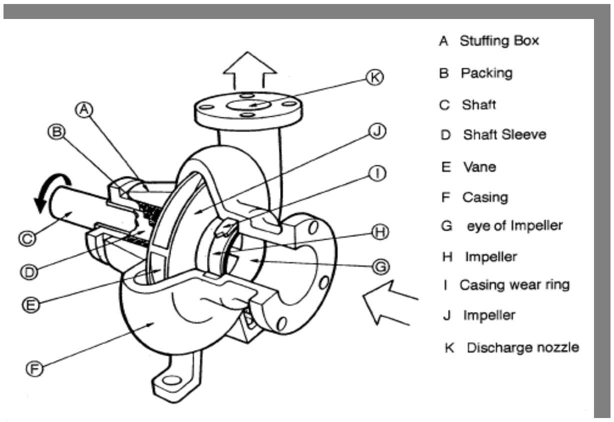
In process operations, liquids and their movement and transfer from place to place, plays a large part in the process. Liquid can only flow under its own power from one elevation to a lower elevation or, from a high pressure system to a lower pressure system. The flow of liquid is also affected by friction, pipe size, liquid viscosity and the bends and fittings in the piping.

To overcome flow problems, and to move liquids from place to place, against a higher pressure or to a higher elevation, energy must be added to the liquid. To add the required energy to liquids we use **PUMPS**.

A pump therefore is defined as ' **A machine used to add energy to a liquid** '. Pumps come in many types and sizes. The type depends on the function the pump is to perform and the size (and speed) depends on the amount (volume) of liquid to be moved in a given time.

2. Working mechanism of a centrifugal pump

A centrifugal pump is one of the simplest pieces of equipment in any process plant. Its purpose is to convert energy of a prime mover (an electric motor or turbine) first into velocity or kinetic energy and then into pressure energy of a fluid that is being pumped. The energy changes occur by virtue of two main parts of the pump, the impeller and the volute or diffuser. The impeller is the rotating part that converts driver energy into the kinetic energy. The volute or diffuser is the stationary part that converts the kinetic energy into pressure energy.



3. Conversion of kinetic energy to pressure energy.

The key idea is that the energy created by the centrifugal force is kinetic energy. The amount of energy given to the liquid is proportional to the velocity at the edge or vane tip of the impeller. The faster the impeller revolves or the bigger the impeller is, then the higher will be the velocity of the liquid at the vane tip and the greater the energy imparted to the liquid. This kinetic energy of a liquid coming out of an impeller is harnessed by creating a resistance to the flow. The first resistance is created by the pump volute (casing) that catches the liquid and slows it down. In the discharge nozzle, the liquid further decelerates and its velocity is converted to pressure according to Bernoulli's principle.

Therefore, the head (pressure in terms of height of liquid) developed is approximately equal to the velocity energy at the periphery of the impeller expressed by the following well-known formula:

$$H = \frac{V^2}{2g}$$

Where, H = total head developed in feet
v = velocity at periphery of impeller in ft/sec
g = acceleration due to gravity 32.2 feet/sec^2
A HANDY formula for peripheral velocity is:

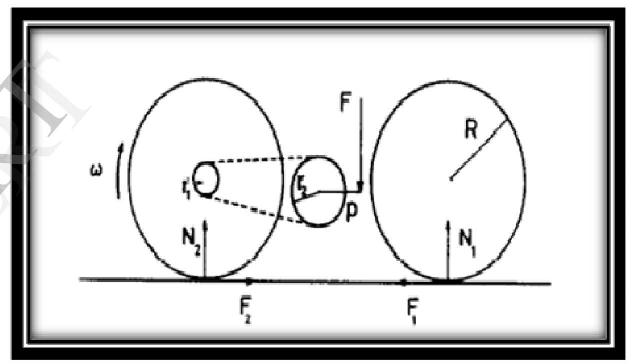
$$V = \frac{N \times D}{229}$$

Where, v = velocity at periphery of impeller in ft / sec
N = the impeller rpm (revolution per minute)
D = impeller diameter in inches

This head can also be calculated from the readings on the pressure gauges attached to the suction and discharge lines.

Pump curves relate flow rate and pressure (head) developed by the pump at different impeller sizes and rotational speeds. The centrifugal pump operation should conform to the pump curves supplied by the manufacturer. In order to read and understand the pump curves, it is very important to develop a clear understanding of the terms used in the curves. This topic will be covered later.

4. General details about bicycle



	Big disk	Small disk
Diameter = D	160 mm	50 mm
Teeth = T	45	18

4.1Ratio between rim & pump pulley

Minimum rpm required for impellers shaft = **1000 to 1200 rpm**

Rpm available in rear wheel = **200 to 300 rpm**

Diameter of cycle rim = **0.6m**

Circumference of cycle rim = **3.14 × 0.6**

International Journal of Engineering Research & Technology (IJERT)
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Vol. 2 Issue 11, November - 2013

= **1.88m**

4.2 Ratio of rim and disk of cycle

An ordinary person run a bicycle at min **20** RPM.

So, we can write $N_1 = $ **20 RPM.**

Diameter of bicycle is **622** mm (universal).

Now we get rpm of back wheel.

Here we take $N_1 = $ **20 RPM**

$$\frac{N_1}{N_2} = \frac{T_2}{T_1}$$

$$\frac{20}{N_2} = \frac{18}{45}$$

$$N_2 = \frac{20 \times 45}{18}$$

$N_2 = $ **50 RPM**

So, we can say that the ratio of disc is **2.5**.

4.3 Diameter of pulley

Here we have $N_2 = N_3$ and $D_3 = $ **622** mm (Universal)

Now we want N_4 = **500** RPM from pulley

So, we find from it

$$D_4 = \frac{50 \times 622}{500}$$

$D_4 = $ **62.2 mm**

So, we decide the diameter of pulley as **62.2** mm.

5. Calculation of the ratio of gear box

$T_1 = $ Teeth of Big gear

$T_2 = $ Teeth of small gear

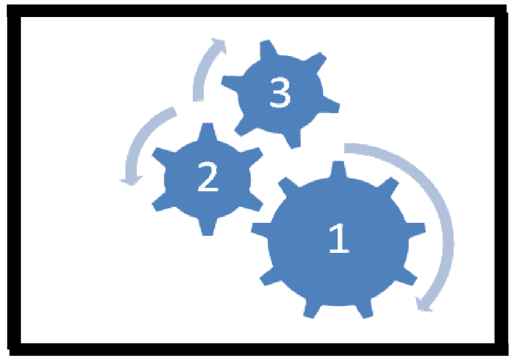
$N_1' = $ RPM of Big gear = **500**

$N_2' = $ RPM of small gear = **2000**

$$\frac{N_1'}{N_2'} = \frac{T_1}{T_2} = \frac{2000}{500}$$

T_1 = 4 T_2

This is a gear ratio of gear which is 4:1.



6. Pumping mechanism

Pumping the water will be accomplished with the use of human power, and presents the most difficult component level design of the system.

The pump must be able to force water to an adequate pumping height without requiring excessive user energy input.

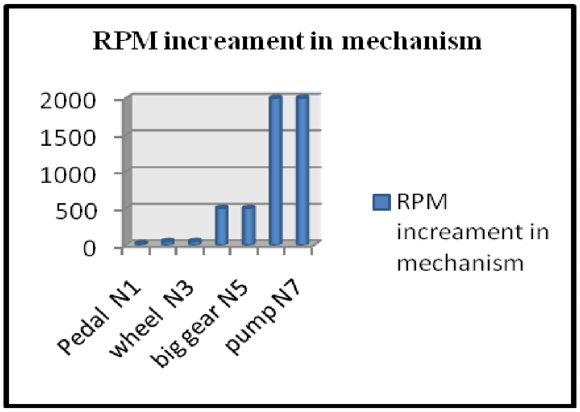
The pump must allow for a wide range of physical fitness levels while still delivering sufficient water.

7. Advantages

The conventional centrifugal pump needs either electricity or diesel engine, but the present innovation works on pedalling. This is a non-polluting and environment friendly device. Since it is made of commonly available materials and costs Rs.3000 it is affordable to common people.

It requires less maintenance and minimum input energy is required to get the maximum output of water. This device can be transported easily from one place to another. The main purpose to develop this mechanism is to save the electricity and cost.

8. Rpm increment in mechanism.



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