International Journal of Advance Research in Science and Engineering
Volume No.07, Issue No.04, April 2018
www.ijarse.com
IJARSE
ISSN: 2319-8354

FABRICATION AND CHARACTERISTICS ANALYSIS OF A PEDAL OPERATED WATER LIFTING PUMP

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ABSTRACT

Thelifting paper deals with the use of pedal operated water pump which can be used to remove the drawback of rural agriculture at minimum cost. Project is based on the principle of centrifugal pump coupled with a cycle to develop enough suction pressure to lift water to a height of 12 feet (3.65 metre). The construction of the pump is simple cost effective. The project consist a simple bicycle on which a centrifugal pump is mounted at its back seat. A chain drive is used to drive the pump which creates a vacuum pressure on suction side of pump and water lifted from the sump side. It is very advantageous because of its eco-friendly nature, which is a matter of prime concern now a days. This machine is made up of very simple and easily available and cheaper components i.e. cycle, chain drive, sprocket, simple nut & bolt & screw for fastening purpose, A frame to hold the bicycle, pump, hose pipes.

I.INTRODUCTION

Water is essential for human being's life and drinking. The water plays major role in everything, from being used in irrigation, to be used in construction, to being used as coolant, almost every activity requires water in some way or the other. Although 70% of earth crust, is filled with water isn't easily accessible due to some problems such as, low water head, geographical etc. Some mechanism helps to tackle the accessibility problem such as electric pump, gas operated pump etc. but they are costlier and create pollution in the environment. Pedal operated water pump is such pump which is environment friendly as well as cost effective, especially in areas where electricity is not readily available such as rural areas or remote areas. It works on a simple mechanism of centrifugal pump.

A pump is basically a basically a device which converts mechanical action to motion of the fluid

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II.LITERATURE REVIEW

2.1Vishal Garg, Neelesh Khandare,Gautam Yadav[1]

This paper deals with the design and construction of pedal operated bicycle which can be used in small irrigation such as water irrigation.The author elaborates the theoretical aspects of the pedal operated water

pump.

2.2 Arvind T. Wadgure, Ishan P. Lade, PrashimK. Kambale, RunaliV.Kaware[2]

had experiment onBi-cycle operated centrifugal pump mechanism for water lifting its 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.

2.3 Jayant Gidwani, Amit Kesheorey, Ratnesh Mishra, Rahul Lowanshi, NiteshLowanshi[3]

They had conducted Pedal powered water pumping and purification 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 used for irrigation. Delivery head is obtained up to 1.03 m.

2.4 Manwatkar Sheetal Prakash , Dr Shahare Achal [4]

The objective of their study was to design the water lifting system which is operated by manual effort. The main purpose of their paper was to compare between all the present and future water lifting system.

2.5 Sagar Vanjari, Jayesh Mahajan, Amradeep Landge , Rahul Bajaj [5]

They worked on the design and fabrication of Pedal operated water pump which can lift the water 20-30ft. The power developed by their device was 1.818kW.

2.6 Maanyam. Sairam, Seetaram Sandeep, Sai Prahallad, Sachin Gogoi, M.V.Sukumar Reddy, Dr.S.Ranganathan [6]

had conducted an experiment on Pedal powered water pump. It can be constructed using local materials. This machine can lift water at 2-3 gallons per minute from wells and boreholes up to 23ft. depth. It can provide water for drinking and irrigation where there is no electricity.

2.7 Understanding The Literature Review And Addressing The Problem

Pedal operated water pump can be made using local material and mild skills. It can help in irrigation, especially in rural areas. The POWP is not only pollution free but also provide healthy exercise. Above experiment lacked portability. The main purpose of ours is to make this machine portable. It shall serve as a water pumping device as well as a transport device.

III.PRINCIPLE OF OPERATION

The mechanism of the operation of our project is simple and effective. From the figure given below, when the pedal crank arm of the cycle is rotated by some effort, the chain attached to the sprocket rotates the rear wheel.

The rear wheel sprocket is coupled to the pump shaft by a chain drive. The impeller of the pump are rotated that generating a vacuum pressure at the sump side of the pipe. The water from the sump is lifted due to the difference in pressure which makes the pump to deliver water out at the delivery end.

The one of the few drawback of this pump is that priming is required to be done before hand so the machine can work efficiently.

IV.DESIGN AND CONSTRUCTIONAL LAYOUT

The designing of Pedal operated centrifugal water pump requires complex analysis in order to lift the water at particular height, at which the water has to be lift. And

according to that the pump has to be chosen and after that the size of the cycle that can lift up to that height and should be quite cheap and easily fulfil our requirement. Figure sketch describe the constructional layout of our project "Pedal operated water pump".

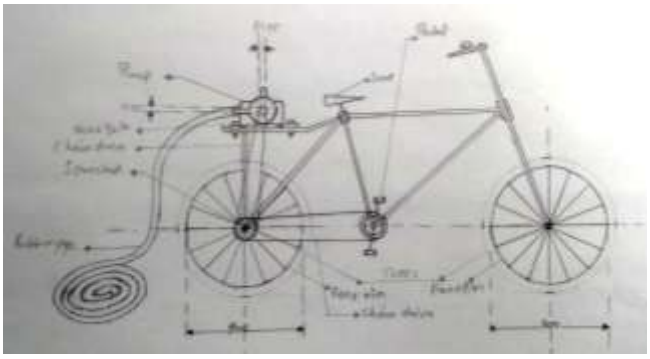

Fig. Systematic Diagram of project

The Construction of the project comprises of few main parts which are also given in the fig. 1 Bicycle being as the primary component which provides the mechanism to operate the centrifugal pump attached on the rear seat.The bicycle is a general purpose Hero cycle with dimension of the wheel base as front wheel 500mm and rear wheel 500mm. A chain drive connects the Sprocketof the wheel to the shaft of the centrifugal pump. The nuts and bolts are used to firmly hold the different parts together, they are used to hold the centrifugal pump with the rear seat of the cycle.

5.1 Bicycle

It is the driving unit of the project. The cycle used in the

project is a standard Hero Ranger which is made of Aluminium alloy that is TIG welded. The wheel rim dimension of the cycle are 500mm*500mm for front and

rear wheel. In our project we have used a second hand Hero Ranger cycle to reduce the cost of the project

Fig. 2 Cycle

5.2 Chain Drives

Chain drives is a device which transmits power from the one end to the other. Chain drive can be defined as a series of links connected by pin joint. The roller chain is required to connect the ends of sprockets. The sprocket is fixed on the rear wheel and the pump shaft. Another chain drive is connected with the pedal to the rear wheel of the cycle.

Fig. 3 Chain Drive

5.3 Centrifugal Rotary Pump

Centrifugal pump is a rotary pump which pumps fluid from suction end to the delivery end. These mechanical devices converts mechanical energy into hydraulic energy. They are based on the conservation of energy which is explained below.

(a)

Fig. 4 Centrifugal Pump Using

5.4 Sprockets

These are used to transmit the rotary motion between two shaft, we used the sprocket in between the pedal and rear wheel, and also in between the rear wheel and the pump drive. We are using sprocket having 18 number of teeth.

Fig. 6 Sprocket Wheel

V.OUR PROJECT BASED ON THISSTATEMENT

"during steady flow, the energy at any point in a conduit is sum of the velocity head (v), pressure head (P) and elevation head (z). It takes the form of a conservation equation where the sum of the three variables will always remain constant as long as no losses or additions occur" [7]

After pedaling the cycle the kinetic energy is transferred into the pump. 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 that is coming out from an impeller is harnessed by the force is creating a resistance to the flow. The drop in the velocity head and pressure head of the liquid causes an increase in the static head of the liquid. That makes the water to lift at a long height.

To calculate peripheral velocity

$v = \pi * D*N/60$

Where,

v = velocity at periphery of impeller in m/sec

N = the rim rpm (revolution per minute)

D = impeller diameter in mm

1. SPECIFICATION

Diameter of wheel rim =**500mm** each

Circumference of cycle rim= **3.14x0.5**

No of teeth of Sprocket of rear wheel (Z_1) =**18**

No of teeth of Sprocket on pump end (Z_2) = **42**

Diameter of inlet and outlet of pump = **31.75mm**

Diameter of pump sprocket = **0.02 m**

Avg. Speed of cycle =**4.30 m/sec**

2. CALCULATION:

D =0.5m (Diameter of rim)

We assumed,

Peripheral velocity = Avg. velocity of cycle

Peripheral velocity = 15.5 km/hr.

Or = 4.306 m/sec

Also since both rim and sprocket are rigid component.

N sprocket =N rim

RPM of rim = $\frac{60V}{\pi D}$

N rim = 165rpm

Z_1 = teeth of sprocket at rear wheel = 18

Z_2 = teeth of sprocket at pulley end = 42

Velocity Ratio (VR) = $\frac{Z2}{Z1} = \frac{N1}{N2}$

$N_2 = \frac{N1Z1}{Z2}$ = 70.7 rpm

The chain used in the project is 10 A roller chain

From the book "Design of machine elements by "V.B. BHANDARI," table 14.2 gives relation between pinion rpm and rated power (KW). [8]

For 70.7 rpm of pinion, Power developed rating of chain is 1.83 KW.

We know, P = $\frac{2\pi NT}{60}$

Or T = $\frac{60P}{2\pi N}$

T =96.08 Nm

i.e. torque required to drive the pump.

While rated power = 0.711 KW.

VI.RESULTS

The rated power of our project is 0.711 kW

The torque required by our project is 96.08 Nm

The height that we achieved is 12 feet (3.65 metre)

Fig. 10 Project Picture

VII.FUTURE SCOPE

- With inbuilt some coupling and gear train mechanism, the machine can be made into a sprinkler, even while riding the cycle, for easy irrigation.
- Flexible pipes can be used, that can be folded and accommodated in project itself to enhance the aesthetic of the project.
- With some modification, such as coupling the shaft of the pump to other rotating devices, the project can serve multiple functions such as pedal operated washing machine, crop cutting machine etc.
- We can also produce electricity and can store in the battery by using the dynamo DC generator.

VIII.CONCLUSIONS

After working on the project we arrive on the following conclusion:-

- The running cost of electricity is high because of high prices of electricity per unit.
- The pedal operated water pump solves the above stated problem.
- It can also be used in remote areas such as mountain or near a river bank.
- The project is portable and easy to commute with it.
- It is a cheaper pump since operatory cost is zero.
- The project is eco- friendly and it will be highly demand in future.

IX.ACKNOWLEDGEMENTS

Weconvey our sincere gratitude to our institute & to Dr. Devendra Jha, (HOD and Dean) of Mechanical Engineering for encouraging us for this project. Special thanks to our guide Mr. Kapil Dev Sharma, (Assistant professor), of Department of Mechanical Engineering.And Mr. Dhruv Kumar (Assistant professor) and Mr. Ashutosh Singh (Assistant professor) of Department of Mechanical Engineering arethe supervisors of this project work. We are extremely grateful to him for his expert, sincere and valuable guidance. We would like to thank the staff and colleagues for their useful support.

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