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Design and Experimental Investigation of Pedal Powered Water Pump

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Abstract: ***The aim of this project is to create a pedal powered water pump by using centrifugal pump. The purpose of this work is to build the pedal powered water pump. Replacing the existing electric system into pedal powered operating system to pump the water. This is a low cost system and it can be placed anywhere, the main advantage of this system is no use of electricity.***
This project deals with pedal powered centrifugal pump. The two main components of a centrifugal pump are the impeller and the casting. The impeller is a rotating component and the casing is a stationery component. In centrifugal pump, water enters axially through the impeller eyes and water exists radially. The pump casing is to guide the liquid to the impeller, converts into pressure. The high velocity kinetic energy of the flow from the impeller discharge and leads away of the energy having imparted to the liquid comes from the volute casing. The centrifugal pump is the most useful mechanical rotor dynamic machine in fluid works which widely used in domestic, irrigation, industry, large plant and river water pumping system.
The present work deals with construction and modelling of pedal powered centrifugal pump. A small prototype is made. This can be achieved by various component such as half HP centrifugal pump, bicycle, stand and various attachments.
Keywords: centrifugal pump, impeller, pedal powered, volute casing, kinetic energy.

I. INTRODUCTION

In under developed countries are used medium head, low volume pumps. Such pumps, however satisfy stringent constraints due to which they are exposed. The units must be extremely low cost, ultra-reliable and almost elegantly simple. They must be simple enough in construction that local people dependably trained for the maintenance and operation of these units cost and need of fuel, lubricants and maintenance eliminate when we used pedal powered water pumps. This leads to the simple power source-human power. Various schemes have been devised for producing and coupling muscle power. But, by far the most applicable, is the bicycle and the drives achieved from it. This is due to the world wide availability of low cost bicycles. The mechanism is simplicity, low cost, low maintenance in the pump unit. The mechanism consists of centrifugal pump which is attached with the rear wheel of the bicycle. This project could helpful for rural areas.it can be used mainly for irrigation an 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 comprise a working bicycle, impeller, pulley and inlet and delivery pipes.The test pump was built by a rear wheel of bicycle is attached to the driving shaft of pump connected with an impeller through this 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 for pumping water for irrigation and cultivation

II. MODELLING OF PEDAL POWERED WATER PUMP

A. Components of Centrifugal Pump

A centrifugal pump has two main components:

1) A rotating component comprised of an impeller and a shaft

2) A stationery component comprised of a casing, casing cover and bearing

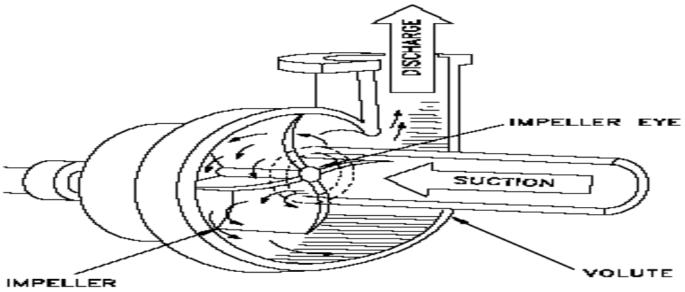

Fig .1 Components of Pump

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B. Fabrication of the Stand

Fabrication of the supported stand designed and model is the main part of the whole idea. The fabrication consisted of many other machining methods like welding, metal cutting etc.

C. Preparation of the Chassis

The preparation of the chassis for the whole set up is considered the main part of the fabrication as it is the main criteria where the rigidity, balancing and stability of the stand is studied and maintained accordingly.by maintain the balancing and stability the equipment gives the guarantee of being operated at any condition or environmental . The machining processes that are used in the making of the chassis are arc welding and metal cutting.

Fig. 2 Design of chassis

D. Welding

Arc welding is a type that uses a welding power supply to create an electric arc between an electrode and the base material to melt the metals at the welding point. They can use direct (DC) or alternating (AC) current, and consumable or non-consumable electrodes. The welding region is usually protected by shielding gas or slag.

III. SPECIFICATIONS OF THE PUMP

1) Capacity of the pump = 0.5Hp
2) Speed of the shaft or impeller = 2500 rpm
3) Head of the pump = 20m
4) Diameter of shaft = 6cm
5) Rotor diameter = 18cm
6) Wheel diameter = 72cm

The torque required for driving the pump during pedaling is obtained by: The power transmitted from pedal to the pump is given by

$P = 2\pi NT / 60$ (5)

Where,

N = speed of the pump during manual pedaling and T= torque required to drive the pump.

The torque generated by human pedaling is obtained by:

Recall that the power transmitted from pedaling to the pump is given by

$P = 2\pi NT / 60$

Where,

N = pedaling speed and T = torque developed by pedal.

The rated for healthy human being is approximately 250 watts [5].

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IV. WORKING OF PEDAL POWERED WATER PUMP

The mechanism consists of centrifugal pump which is attached with the rear wheel of the bicycle. The system comprises a working bicycle, impeller, pulley, inlet and delivery pipes. A rear wheel of bicycle is attached to driving shaft of pump connected with an impeller through this is used to lift water from a pipe into the form for cultivation. The suction and delivery pipes are then connected to the suction and delivery ports respectively. Manual priming of the centrifugal pump is done next. By pedaling the rpm of the rotor shaft is measured using tachometer. The flow rate of water is measured by using measuring tank and stop watch. Such that the water lifted is measured in terms of liters per seconds.

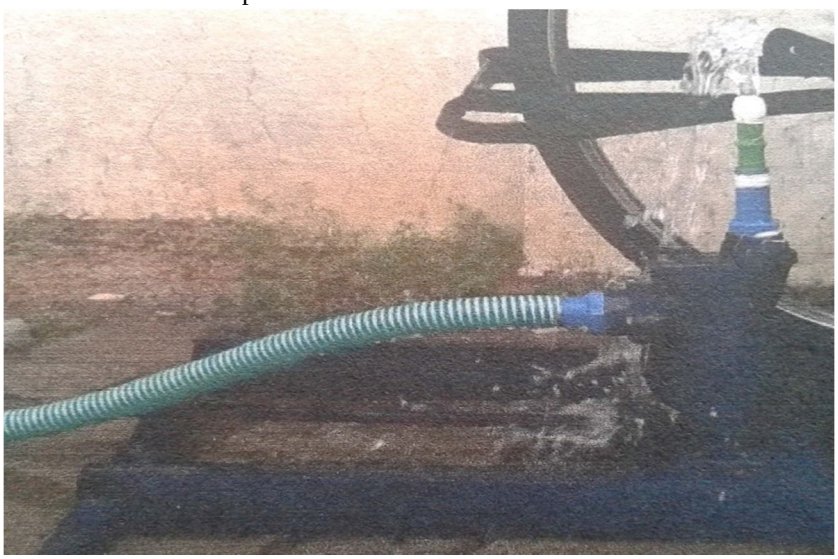

Fig. 3 Working of Pedal Powered Water Pump

V. RESULTS & DISCUSSIONS

TABLE I.

S.NO	SPEED (rpm)	DISCHARGE (liters)	TIME (sec)
01	1900	01	18
02	2300	01	12
03	2500	01	10

From the table I, for pedal powered water pump at the speed of 1900 rpm and discharge for 1 liter, the time taken is 18 sec. Thus, for the speed of 2300 rpm and discharge for 1 liter, the time taken is 12 sec. Therefore, for the speed of 2500 rpm and discharge for 1 liter, the time taken is 10 liters.

It is observed from the fig 4, that as the speed of the pedal powered water pump at various speed increases at same discharge rate, time decreases gradually

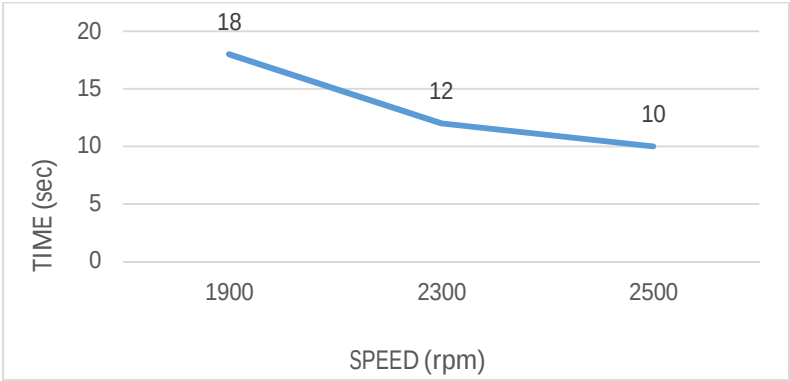

Fig. 4 graph show variation of time vs speed

It is also observed during experiment that:

1) 1 complete revolution of pedal powered is equal to 3 revolutions of wheel.
2) 1 complete revolution of wheel=72/18=4 revolutions of impeller shaft.
3) 1 complete pedaling = 4*3=12 revolutions of impeller shaft.

VI. CONCLUSION

A. The machine is tested on the farming land and got the satisfactory results.
B. The conventional centrifugal pump needs either electricity or diesel engine, but the present innovation works on pedaling.
C. But the same pedal power can be used for other purposes such as to generate electricity, to operate hand tools or agricultural tools.
D. This is a non-polluting and environment friendly device.
E. It requires less maintenance and minimum input energy is required to get the maximum output of water.
F. This device can be transported easily from one place to another.
G. The equipment is purposely design for the farmers having small farming land.
H. The performance of the equipment will increase when it is operates on the high speed.
I. The whole study over the topic that the bicycle powered water pump is a very advantage especially for rural areas.
J. By use of this project electricity is saved and a particular water head and supply the water for irrigation.

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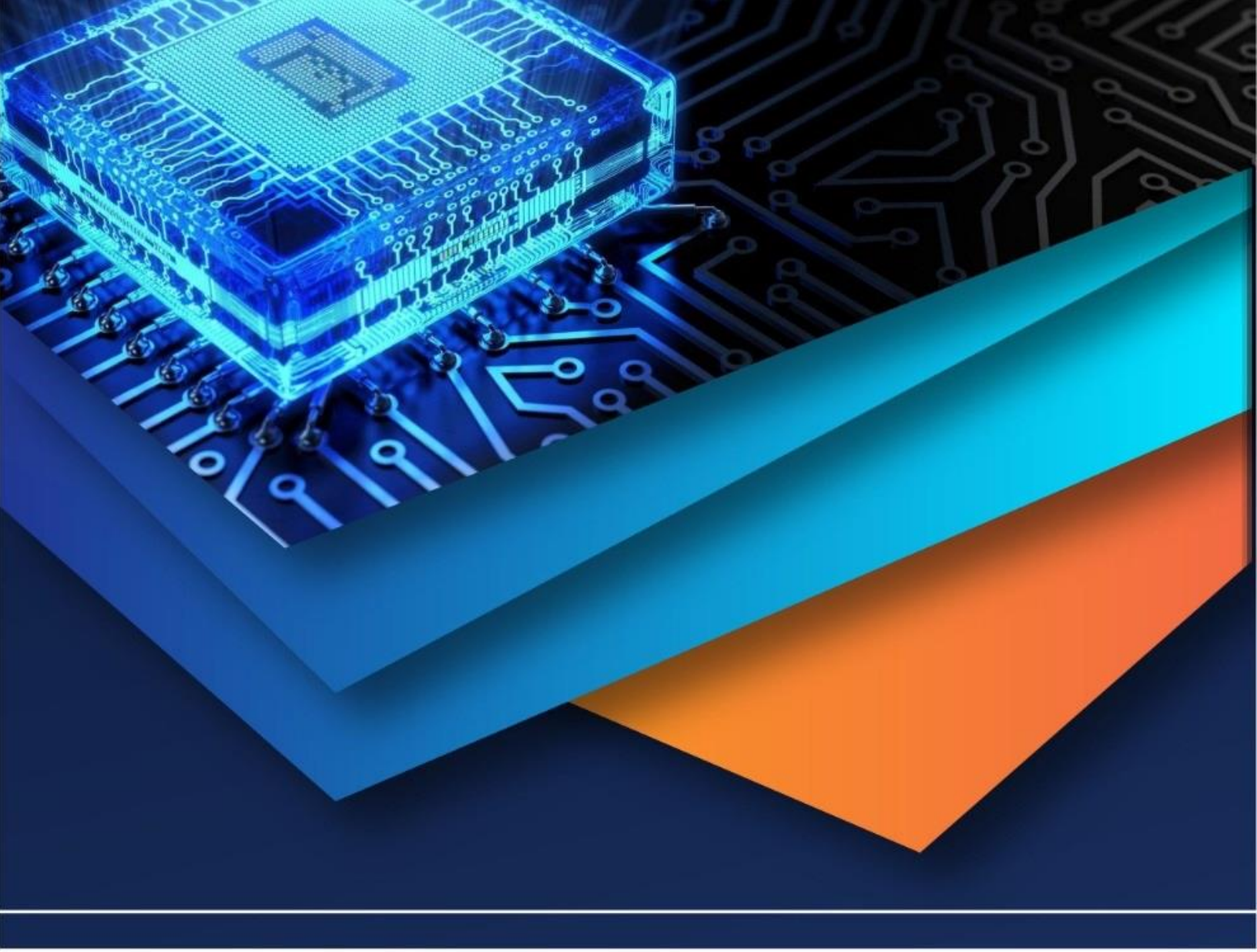

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