Paddle Powered Centrifugal Tube Type Water Pump

Bhaskar Singh Bisht, Arsad Ali, Shivasheesh Kaushik

Abstract— In our project we are making "PADDLE POWERED WATER PUMP". The main motto of our work is to design and develop a prototype of a simply constructed water pump so that it could be operated by human power with the help of hand or foot paddle having flywheel attached to it, which could be further easily modified or assembled to any other power source such as electric power, wind power or any other suitable driver mechanism. In simple language we can say our main objective is to reduce the dependency on the conventional energy resources. It will offer several advantages like financially, environmental friendly, almost maintenance free as compared to other pumps and easily repairable or we can say self repairable by the operator and health wise beneficial. The problem which is also addressed is the idea of harnessing green energy to our root level i.e the agricultural industry which further could be developed as an infinite source of energy which could be used to fulfill our daily energy needs so that we could put a step forward towards our evergreen future.In our water pump we had used a unique design which could be very much helpful for small scale uses such as in agricultural industry, and various other manufacturing industries. The flywheel added to it is the additional feature which supports the operator to an extent. The capacity of our pump is 15ml per sec, working at an average r.p.m of 90 of the driver shaft at the head of 1.5 ft. It could provide water head upto three ranges i.e 1.5 ft, 2.0 ft, and 2.5 ft as the rpm is increased further. At the end, conclusions about the project are made and some recommendations for future development are given.

Index Terms— Centrifugal Force, Tube Type Rotary Water Sucking Pump, Flywheel, Minimum rpm, Cheap, Reliable, Low operation cost.

1 INTRODUCTION

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 pedal pump, powered by our legs instead of arms to lift the water up to 2.5 ft.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 use of 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.

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2 PROBLEM SATEMENT

The aim of our project was to construct an economical and reliable mechanism that would reduce or eliminate the dependence of water pump operation on expansive sources such as diesel or kerosene engines for small scale purposes such as an agricultural industry. And also to develop a substitute mechanism for pumping operation so that losses could be reduced while using expansive water pumping techniques in rural areas for fulfillment of basic daily needs, which would further be developed in much more feasible working condition by using other suitable driver techniques such as wind power.

2.1 Research objective

The purpose of making this project was to develop design which is reliable and is free of complexity so that maximum output could be achieved in economical and eco-friendly way.

2.2 Scope of research

- To make this mechanism more reliable and cheap.
- To find the potential alignment angle of tubes so that output would be maximum in minimum rpm.
- To make the design of collector tank as simple as possible so that construction complexity could be reduced to minimum.
- To use appropriate ratio of gears so that maximum power could be transferred from paddle to the rotating part.

- To select suitable flywheel so that it would be supportive to the operator during its working condition and also it could be modified in the easiest way to get the maximum output.

3 DESIGN CONSIDERATION

Before the designing process of paddle powered water pump began, we developed a list of criteria which would guide us. Four important criteria that we must consider in designing a working model includes the performance, serviceability, manufacturability, economic concerns.

- Performance for the paddle powered water pump was a high priority. The main criteria governing performance was that the pump would provide the required water head at the minimum rpm.
- Serviceability was a concern for this project as it was assumed that, in time the mechanism would encounter unforeseen problems and need maintenance.
- Materials and parts were selected based on their availability and ease of use in repair.
- Economics played a large factor in the design of the pump.

So simplicity of design and ease of manufacture ruled. The collector must be light weighted, rigid, able to hold water weight, and resist light abrasion, as well as support mounting hardware for various system components.
The tubes must also be easily tailored from a light weight water resistant fabric and be rigidly attached with the assembly without damaging to the rest of the craft. Environmental and sustainability criteria did not significantly impact the design of the device as there are no serious environmental concerns which arise from the production and use of the water pump. Health and safety of the user were taken into consideration, though this did not significantly impact design.
There are also no real ethical, social, or political concerns which were taken into consideration as the similar functioning system have been built by many societies in many nations for many different reasons.

Table 1: Design considerations

No	Consideration	Priority	Comments
1	Performance	Essential	Must transport over land
2	Serviceability	Essential	Must be easy to maintain
3	Manufacturability	Essential	Must be constructed with limited resources
4	Economic	High	Must minimize cost

4 MATERIAL AND METHODOLOGY

The project was constructed in following phases:
☐Collecting tank construction
☐Adjustable legs construction
☐ Tubesinclination
☐ Flywheel positioning
☐ Power transmission (gear) positioning

4.1 Collecting tank construction

The collecting tank is one of the necessary components of our system. It has all the mountings over it. It is made up of tin alloy which is easily available in the nearby market. The designed geometry is important as it will house all of the components and must take all of the respective loads. Tin alloy was selected due to its light weight and strength properties. A passage is attached at different drainage points that will allow uniform distribution of water so that proper drainage rate could be achieved. So, the tank is having its basic geometry design i.e frustum, passages are attached to its surface at different drainage points and at its top surface all the other necessary components are mounted. Hence the structure made is strong and rigid.

4.2 Adjustable legs construction

We had made our adjustable legs of iron alloy which we found in nearby market. Its selection was done due to its light weight and strength properties. Its design supports the weight of the collector tank with additional water collected within it. We preferred to fix each of the four legs with each other so that vibration losses could be avoided and any further system loss could be avoided. For the height adjustment purpose three holes are drilled at the top portion of the individual legs providing respective gaps.

4.3 Tubes inclination

The tube selection was done focusing light weight of the material, hence we selected copper tubes for our use as it was easily available and feasible. Its additional features are its surface does not degrade in water contact, it can resist minor stress and abrasion and also it is easily machinable.

4.4 Flywheel Positioning

In our design we had tried to make our system as compact and simple as possible. As a result we aligned the rim flywheel with the power transmission shaft, thus it helps us in transferring continuous power to the system. The continuously transferred power provides the useful continuous fluid flow from the outlet.

4.5 Gears Positioning

Having aligned all the necessary components of the system now comes the turn of a very crucial assembly i.e the power transferring unit .It consists of the primary part in which the muscle power of the foot is used to transfer power to the foot paddle which further transfers the power to the flywheel with the help of gears connected with the chain drive mechanism. In the secondary part of the power transfer the flywheel transmits the power to the driven mechanism i.e the tubes

aligned with the help of spiral bevel gear assembly having gear ratio of 11:38, while selecting this gear our focus was to transmit power in the perpendicular direction, having efficient gear ratio, and its cost and availability in the nearby market must be as much feasible as possible.

Fig. 1.Isometric view of the prepaired model.

Fig. 2.Front view of the driven mechanism.

Fig. 3.Top view of the collecting tank.

The designed collector tank is collecting water to the level of 1.5 ft with the appreciable efficiency, working at 90 rpm (avg.) of the driven shaft.For achieving water at increased heights the rpm should be increased accordingly. The proposed model has many advantages such as:

- It is highly adjustable at various height of output required.
- After doing some minor changes in the design it could be made much more reliable.

The principle behind the working of inclined tubes is the creation of vacuum because of the centrifugal force generated by the action of speedy rotation of driven mechanism. In our pump we had used six such pairs of hollow tubes so that necessary volume of water could be raised.
Minimum working rpm – 90 rpm.
Radius of hollow tube – 4 mm.
Length of tube inclined – 300mm.
Angle of tube alingnment – 30^0.
Gear ratio – 11:38.

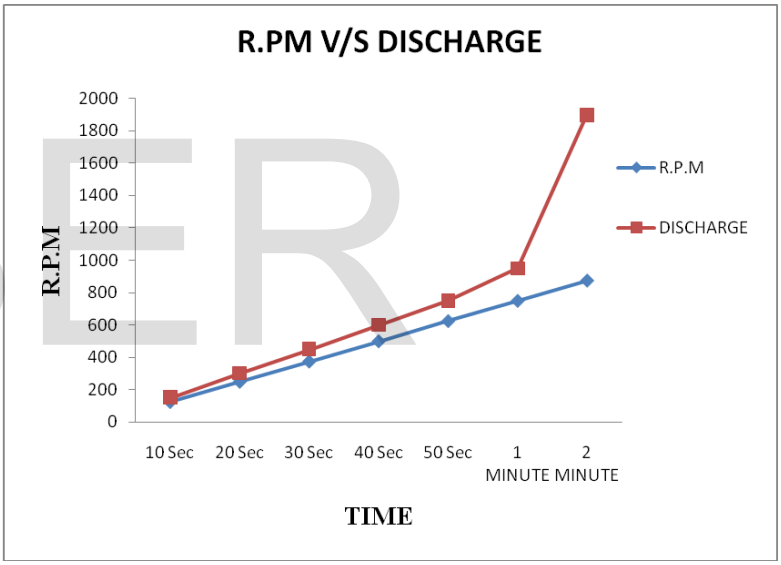

Fig. 4.Graphical representation of the results obtained.
Note: Here discharge is in 'ml'.

6 Conclusion

During the testing of all criteria put forward, the project was deemed a success as it met virtually all of the listed criteria. The primary goal was to make a simple design so that construction and fabrication could be done in easy and cheap way. We were successfully able to design a collector tank which acquires more space as compared to other operating water pumps but at the same time it has the simplest mechanism of operation, and if further study is carried out in the design it would be much more efficient then it is at the present. The uniqueness of our pump is that if it is properly designed it would be maintenance free for a very long period of time, at the same time it is very flexible as it could be adjusted between the range of 1.5 ft to 2.5 ft water head output and also it could be easily assembled with any other suitable driver

mechanisms such as it could easily be driven by adequately designed wind turbine.

In future following objectives could be achieved while working on the project:

- Design of the tubes inclined could be modified to achieve better results.
- By selecting substitute material and machining processes the overall cost of the project could be reduced.
- Water could be collected at increased heights.
- The driving source could be changed such as wind mill could be one of the best option.
- Any other suitable and feasible driven mechanism could be selected.

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