



Fabrication Of Pedal-Operated Water Pump For Agricultural Purpose

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Abstract: Many villages in India have agricultural grasslands nearby a water source. So in order to supply the water to the field, the farmers need to carry plenty of water back and forth from the water body to the agricultural field. With no availability of electricity in such places, it is difficult to use any equipment or motorized pump to run an irrigation system, as a farmer cannot access every corner of the large field to supply water manually. In this paper, we will design and construct a pedal-operated water pump that will be used in small irrigation and farms closer to a water body. The system includes a water pump operated by manual pedal power. This was prompted due to the need for pumping systems that do not use current energy as their power source in an underdeveloped area. They can be built using locally available materials and can be easily adapted to suit the needs of local people.

Keywords – Agriculture, Adapt, Irrigation, Village, etc.

I. INTRODUCTION

In villages of developing countries including India, human muscle power can be a good alternative to fulfill the energy requirements for performing many activities like water pumping. This work will eliminate the use of motors and engines to run the pump and it will use the energy which will not create any pollution. Pedaling is the most efficient way of utilizing power from human muscles. The idea of pumping water has been in existence since the evolution of man. Pumping plays a very pivotal role in the day-to-day existence of mankind and as a result, different methods have evolved over the years to pump or displace water. Water supply has been a very critical issue, mostly affecting the rural areas. Water is one of nature's most important gifts to mankind. Years range from man-powered operated ones down to the more efficient ones. Water is a colorless, transparent, odorless, tasteless liquid that forms the seas, lakes, rivers, and rain and is the basis of the fluids of a living organism. Our ancestors built many of their villages and towns near springs and rivers so that they could get water easily. There is evidence around the world of early peoples using pipes and ditches for moving water to where people lived. They were also digging deep wells and making dams to collect and store water. It is one of the most essential elements to good health and as such, it should be readily available to everybody.

Our project on the fabrication of a pedal-operated water pump initiated from a source gave us the knowledge that in some villages with electricity there are still many farmers who have to transfer water from a nearby pond to their field using loads of manpower just to supply water. We started working on our first phase of the project where we gather the materials required and the designing of the water pump using drawings and CAD models. The study and gathering of information from various sources helped us to assemble a better idea to be put to use for the farmers practicing agriculture.

II. PROBLEM DEFINITION

There are remote agricultural farms where electricity is unavailable and there is a water source present right next to the field. To supply the water to the field manpower is required to carry water in large amounts from the pond to the crop field. Large agricultural farms need an irrigation system as a farmer cannot access every corner of the large field to supply water manually. An electric pump is required for an irrigation system but due to no electricity in remote areas, the irrigation system cannot be used.

Objective

The following are likely to be focused on and achieved at the end of the project.

- 1) To provide help for villages having farmlands in remote areas where electricity is not available.
- 2) To provide water to every corner of the field.
- 3) To reduce human energy compared to walking from the pond to the field carrying water.
- 4) To reduce maintenance and cost by using resources for agricultural purposes.

III. METHODOLOGY

Fabrication is done to make a simple piece of equipment. Its purpose is to convert the energy of a prime mover into velocity or kinetic energy and then into the pressure energy of a fluid that is being pumped. The energy changes occur by virtue of two main parts of the pump, the impeller, the pedal mechanism, and the impeller vanes. The impeller is the rotating part that converts driver energy into kinetic energy. The vanes of the impeller convert the kinetic energy into pressure energy.

- 1) As the person pedals, the crank rotates which revolves around the crankshaft. This makes the belt over the crankshaft to turn the belt to move in one direction. This motion to the belt causes rotation of the impeller shaft on the other side of the belt.
- 2) The main 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.
- 3) 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.
- 4) The first resistance is created by the pump volute (casing) that catches the liquid velocity is converted to pressure. Due to this the impeller rotates creating a vacuum which causes the suction of water through the suction port. The water is carried through the impeller and then discharged through the delivery port

Part List

| COMPONENT | MATERIAL | PROCESS |
|-----------|------------------|---------------------------------|
| Crank | Plastic | Cutting |
| Belt | Rubber / Rope | Joining |
| Shaft | Plastic | Cutting |
| Pedal | Wooden piece | Cutting and Joining |
| Frame | Wooden / Plastic | Cutting, Drilling, and Screwing |
| Impeller | Plastic | Cutting and Joining |
| Pipes | Plastic | Cutting |

Table 3.1 Part List

3.3 DESCRIPTION PARTS AND COMPONENTS

The following are the major components of our projects.

Belt

A belt is a loop of flexible material used to link two or more rotating shafts mechanically, most often parallel. Belts may be used as a source of motion, to transmit power efficiently, or to track relative movement. Belts are looped over pulleys and may have a twist between the pulleys, and the shafts need not be parallel.

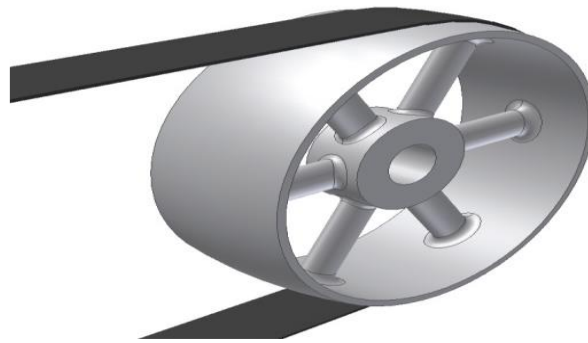


Fig 3.1 Belt and Pulley.

Shaft

A shaft is a circular cross-section that rotates and transmits power from a driving device, such as a motor or engine, through a machine. Shafts can carry gears, pulleys, and sprockets to transmit rotary motion and power via mating gears, belts, and chains.



Fig 3.2 Shaft.

Impeller

The two main parts of the pump are the impeller and the diffuser. Impeller, which is the only moving part, is attached to a shaft and driven by a motor. Impellers are generally made of bronze, polycarbonate, cast iron, stainless steel as well as other materials. The diffuser (also called volute) houses the impeller and captures and directs the water off the impeller.

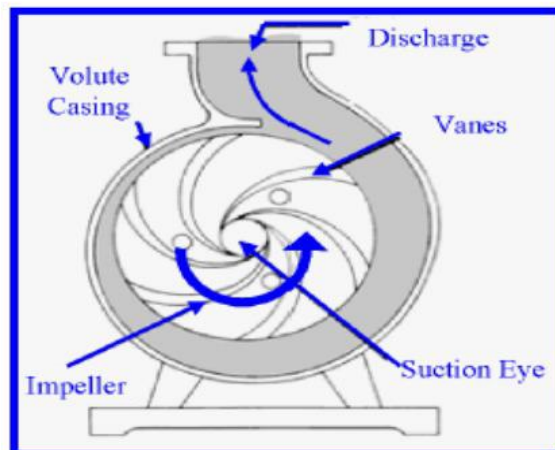


Fig 3.3 Impeller.

3.3.4 Pipes

Plastic pipe is used for the conveyance of drinking water, wastewater, chemicals, slurries, gases, compressed air, irrigation, plastic pressure pipe systems, and vacuum system applications. Plastic pipe comes as either ABS (acrylonitrile-butadiene-styrene) or PVC (polyvinyl-chloride).



Fig 3.4 Pipes.

Flow Chart Of Working

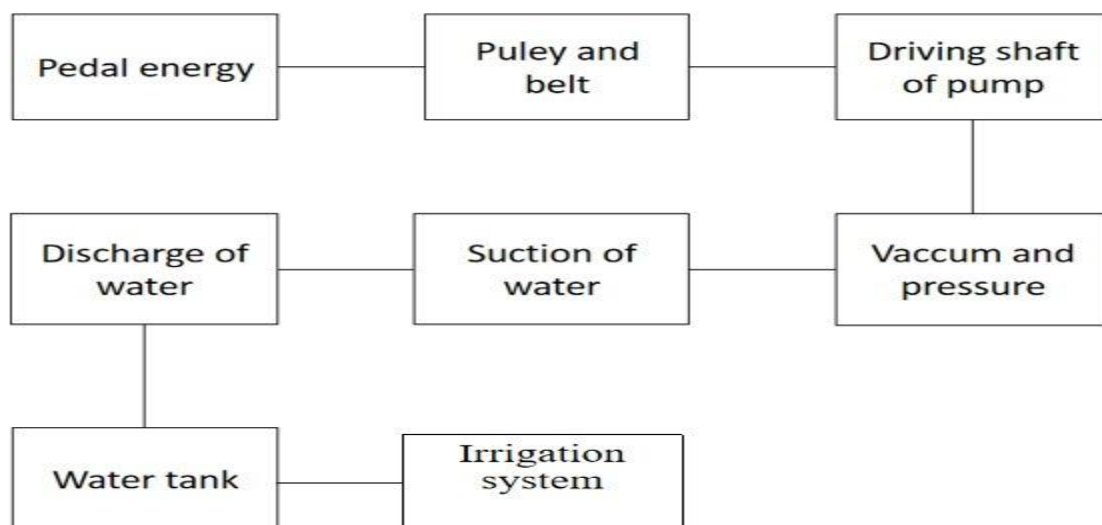


Fig 3.5 Flow chart

3.5 CONSTRUCTION AND WORKING

CONSTRUCTION

- A frame is fabricated in such a way it holds the pedal-crank as well the rotor mounting.
- The impeller shaft is connected to the crankshaft using a simple belt drive mechanism.
- One end of the belt is at the impeller shaft while the other is at the crankshaft.
- Two pipes are connected to either side of the impeller mounting, one at the suction port and the other at the discharge port of the mounting.

WORKING

- As the person pedals, the crank rotates which revolves around the crank-shaft.
- This makes the belt over the crank-shaft to turn the belt to move in one direction.
- This motion to the belt causes rotation of the impeller shaft on the other side of the belt.
- Due to this the impeller rotates creating a vacuum which causes the suction of water through the suction port.
- The water is carried through the impeller and then discharged through the delivery port.

ADVANTAGE

- It is renewable as well as sustainable. As it is needed till the human existence on this planet and the ultimate source is the human himself.
- Pedal renewable is cost-effective so everyone can access its advantages. There is only a need to set pedal with crank system attached to the drive.
- It is pure energy with zero percent carbon emission so clean and healthy surroundings.
- It keeps the body system well and increases the efficiency level if used to a certain extent. Excess use of anything is bad for health.
- It does not harm the socio-political benefits as it is the personal property of every individual.
- The conventional centrifugal pump needs either electricity or a diesel engine, but the present innovation works on pedaling.
- This is a non-polluting and environment-friendly device. Since it is made of commonly available materials and costs less. It is affordable to common people. It requires less maintenance Minimum input energy is required to get the maximum output of water. This device can be transported easily from one place to another.

IV. FIGURES AND TABLES

4.1 Cost analysis

| COMPONENT | COST |
|--------------|---------|
| Crank | 20 |
| Belt | 20 |
| Shaft | 10 |
| Pedal | 20 |
| Frame | 40 |
| Impeller | 40 |
| Pipes | 20 |
| Average cost | 100-200 |

Table 4.1 Cost Analysis

4.2 3d cad model

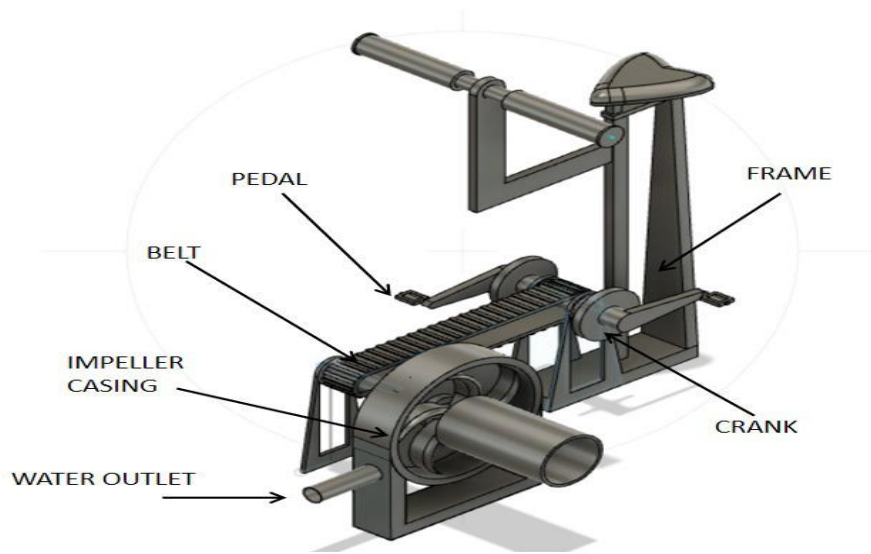


Fig 4.1 CAD Model side view

V. CONCLUSION

The problem of energy crises is very big in India as many rural farm areas have no access to an electrical power supply. This makes water transportation and irrigation difficult even though they have a water body next to the farm. So to discharge a high amount of water from the water body to the agriculture field quicker by using less energy we provide a simple and efficient way of pumping water utilizing a human-powered pedal-operated water pump for agriculture purposes to communities where electricity is unavailable or impractical. Thus, to provide equipment easy to maintain, use, and environment sustainable and mainly affordable to the agricultural communities.

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