

ANALYTICAL STUDY OF COMPONENTS USED TO MAKE PEDAL OPERATED CENTRIFUGAL PUMP

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ABSTRACT

The lifting 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. 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.

1. INTRODUCTION TO MECHANISM

Bicycle operated pedal pump consists of mechanism of simple pedal which is fixed on the rear wheel bicycle. Paddling for a short duration, it lifted 10-12 gallon water to a height of 4m. This project is useful for rural areas where electrification is a challenge. It can be used for water lifting from wells and can be used to lift water from ground level at the time of flood.

The system consist a bicycle, rim, impeller, pulley, inlet and delivery pipes. Centrifugal pump is mounted on Rear wheel of cycle which is connected to the rotation of wheel which creates the vacuum in pump. This project is useful in many ways like lifting water from different kinds of water bodies like river, ponds, wells etc. by using a paddling operation in rotational force. When we drive a bicycle, the rear wheel of the bicycle rotates at particular rpm using paddle. And this wheel rotates the impellers of the centrifugal pump by sliding action between wheel and pulley but the rpm of the wheel is very low so we can't get required head for water and

power effort on the paddling is low so we can use the pulley which is mounted on the shaft of the pump for easy lifting of water for generating high speed in less power. [1]

2. TODAY'S METHOD

By using the electrically operated Centrifugal pumps we can pump the water as a sub-class of dynamic axis symmetric work-absorbing machinery. Electrical operated Centrifugal pumps are generally used to convert the rotational kinetic energy of pump to the hydrodynamic energy of the liquid flow. The rotational energy comes from electric device like motor. The fluid enters the pump impeller along to the rotating axis of paddle and is accelerated by the impeller, flowing radials in chamber outward into volute chamber, from where it exits. It contains various common uses include petroleum, water bodies, and petrochemical pumping etc. The function of the centrifugal pump is for converting potential energy of water pressure into mechanical rotational energy of pump.



Fig. 1 Centrifugal Pump

When there is a certain mass of liquid that is made to rotate by an external force, then it is thrown away from the central axis of rotation and a centrifugal head is impressed which enables it to rise to a higher level to the ground surface, and this is how water is lifted up in height.

The centrifugal force is created by the impeller spinning at high speed inside the pump casing.

3. PARTS OF PUMP

- i) A stationary element made up of a stuffing box, casing (volute), and bearings.
- ii) A rotating element which includes a shaft and an impeller.
- iii) A set of rotating vanes called an impeller.

4. DESIGN AND CONSTRUCTIONAL LAYOUT

The designing of Pedal operated centrifugal water pump is not so easy as compared to the height, at which the water has to be lift. And according to that the pump has to be choose 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. The sketch describe the constructional layout of our project "Pedal operated water pump".

The Construction of the project comprises of few main parts which are also given in the fig. Bicycle being as the primary component which provides the mechanism to operate the centrifugal pump attached on the rear seat. [5]

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 sprocket of 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. [2]

4.1 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. We mainly bought it from OLX.



Fig. 2 Bicycle

4.2 Chain drive

Chain drive 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

4.3 Support frame

The support frame is the part which support our device during its operation. The frame is made of mild steel by joining the metal pieces together by welding. The cast iron frame are used to absorb shocks and reduce vibration losses. But welding of cast iron is difficult hence we used mild steel frame.

4.4 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.

There are another sprocket wheel present in the bicycle at pedal drive and at rear wheel



Fig. 4 Sprocket

4.5 Rubber pipe

We are using the rubber pipes to deliver the water at some distance at both the ends of the pump. We are using 4-5 meter of pipe in this project.



Fig. 5 Rubber Pipe

4.6 Centrifugal pump

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



Fig. 6 Centrifugal Pump

4.7 Elbow

It is a curved steel rod having one side threaded and one side plain, for the attachment of the rubber pipe in it.



Fig. 7 Elbow

5. OPERATION

By using the kinetic head, centrifugal pump drives fluid, utilizing an impeller and a circular pump casing. Now fluid is drawn to the impeller through suction by making a vacuum in the pump and the liquid discharge from the pump. Centrifugal pumps can also achieve very high flow rates by forcing fluid without cupping it. The rate of speed of pedal in rpm depends upon the flow rate of pump. For achieving more height we have to increase the speed of pedal or increase the diameter of rear wheel or pump capacity.

6. MECHANISM INVOLVE

The pump converts energy of an mechanically operated motor into velocity and then into pressure energy of a fluid. Conversion from velocity head to pressure head is done by impeller and casing. At low pressure, high volume delivery makes pumping effect.

7. DEVELOPMENT OF GOVERNING FORCE

The centrifugal acceleration is provided by impeller, spins the liquid sitting in the cavities between the vanes. A low-pressure area is created causing more liquid to flow toward the inlet when liquid leaves the eye of the impeller. The fluid is pushed in a radial and tangential direction by the centrifugal force because the impeller blades are curved and this force acting inside the pump is the same as one that keeps water inside a bucket rotating at the end of a string. Fig. below indicating the movement of the liquid via side cross-section of a centrifugal pump. [3]

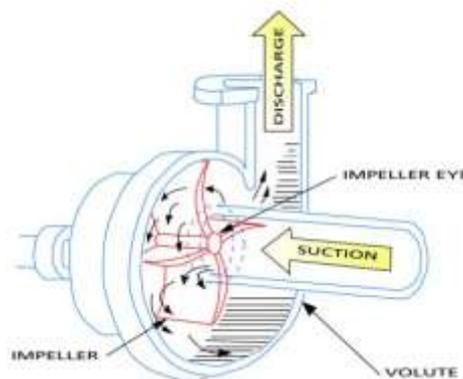


Fig. 8 Cut section of rotary pump

8. MAJOR COMPONENTS OF THE PUMP

a) Stuffing Box – A gland packing assembly or mechanical seal assembly is provided to seal the leakage of fluid from where the shaft comes out the pump casing and fitted in stuffing box/gland housing in the pump housing. Sealing is mounted between the stuffing box housing and shaft sleeve which is made up of asbestos/glass fiber/filled Teflon rings. Gland packing requires renewal at fix interval but it is economical in use. Also, it do not gives zero leakage assembly. Small amount of leakage is essential to maintain for cooling of gland ropes. Mechanical seal assembly are used for all hazardous services but for non-critical services, non-toxic gland packing is used in industrial pumps.

b) Packing – The substance which is normally come in the actual size of the layout of the packing work where seal packing is needed at the time of dismantle.

c) Shaft Sleeve - A sleeve is fitted between the bore of the OD and impeller of the shaft and keyed with the shaft i.e. impeller rotate with the sleeve along with the shaft and are used widely used in single stage pumps. Sealing gland and impeller are not directly mounted on the shaft. The function of the impeller sleeves is to come in

contact with the pumping fluid and to protect the shaft from wear. In this type of assembly the wearable part is the sleeve i.e. less expensive than shaft.

d) Vane – After the application of rotational force on the shaft having wide area which rotates with the shaft connected with it and comes in the middle of the pump. [4]

e) Casing - The pump efficiency will be lowered and abnormal vibration increases if the clearances between the casing wear ring and impeller wear rings exceeds. Easy and economically renewable relative movement joint between the casing and the impeller is provided by wearing ring to protect the damage of casing or impeller.

f) Impeller –It is one of the main rotating part of the pump that imparts the centrifugal acceleration to the fluid. In many ways, impellers may be classified. [6]

g) Discharge nozzle – It is of the circular cross sectional last part of pump from where the discharge takes place from the pump.

9. ADVANTAGES

1. We can easily lift up the water by using this.
2. Also, we can save the electric power.
3. It is very portable.
4. This is cheaper as compared to other methods.
5. Both cycling and gardening can be done simultaneously.

10. DISADVANTAGES

1. For maximum lifting the water, it is not desirable.
2. In this, high man power requirement is high.

11. CONCLUSIONS

As per the study over the topic that for the rural areas the bicycle powered water pump is a very advantageous. The energy problem is very big in India and by use of this project we can save electric power we will operate a water pump by using bicycle operated mechanism in the project and the water will lift up. Wheel of the bicycle rotates when we pedal's a bicycle so we can provide a pulley over the wheel for high rpm .The impeller is rotated due to rotating of wheel with rotation of pulley and the pulley is mounted on the shaft impeller of the pump. Thus, we operate the pump and lift the water at a particular head. It can be installed in any of the place where water bodies are present nearby. This can also placed in garden, both gardening & cycling can be done at a time.

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