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Fabrication of Pendulum Pump

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ABSTRACT- This paper discusses the importance of a pendulum pump which can be used as a supplementary device for pumping water and is made to replace hand pumps. One important feature of a pump with a pendulum is that the work is alleviated or in simple terms it makes work rather easier when is compared with a traditional hand water pump. It is due to this underlined feature which enables the pendulum pump to be used as an efficient mode in the irrigation of smaller lots, water-wells and can also be used in extinguishing fires even by old people and children. By the use of pendulum based water pumping system we can increase the efficiency of the plant and reduce the effort, cost of production, production time, manpower requirement.

1. INTRODUCTION

This project presentation shows the importance of a pendulum pump which can be used as a supplementary device for pumping water and is made to replace hand pumps. To get the water running out of the pump, the pendulum needs to be out of balance. After that, based on gravitational potential, the piston starts oscillating and the continuous stream of water is coming out of the output pipe. The pendulum should be occasionally pushed, to maintain the amplitude i.e. the stream of water.
A pump is a device that can be used to raise or transfer fluids. Pumps are selected for processes not only to raise and transfer fluids from one point to another, but also to meet some other criterion. This other criterion may be to obtain a constant flow rate or constant pressure according to the requirement.

The main importance of a pendulum pump is that the initiation energy for starting the process of pumping, swinging of the pendulum, is considerably minimum when compared with the work required to operate hand pumps. Typical hand pumps require sufficiently large effort and an average person can use the pump continuously only for a short time, but the pendulum pump requires only minimum of the effort, because it is only required to oscillate the pendulum and can maintain these oscillations for several hours, without any fatigue. The pump works well with all sizes of the pendulum, but mainly with the amplitude of 90°.

The advantage of this invention compared to present hand pump solutions are: less force to start the pump, less water consumption, both arms can be used to fetch the water. The invention is applicable on other devices that use lever mechanisms, such as a hand press etc.

The most important feature of this is:
The effect of creating the free energy in the device made of:

1. Oscillating pendulum-lever system,
2. System for initiating and maintaining the oscillation of the Pendulum.

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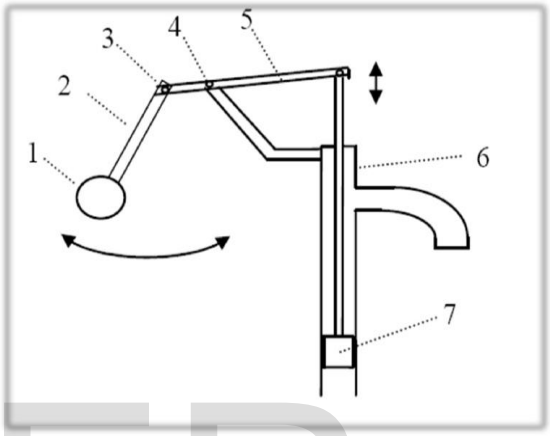


2. LITERATURE REVIEW

This thesis is the design of a small-scale working model of a Pendulum Operated Pump which providing fully pendulum pump functions along with all the features.

Lin et al. [2013] [1] from The State Key Laboratory of Fluid Power Transmission and Control, Zhejiang University, China were acquired experimental data from the semi-physical test rig and analysed validate the energy transmission strategy of dual-medium pressuriser. An onshore pendulum WEC test rig is built to validate the above proposals. A hydraulic cylinder is substituted for the wave that exerts force on the pendulum. Although the force and the output power in the simulation are somewhat different from those in the test results, the overall tendency is the same, and the dual power stroke in one period is clearly shown. Rahul Singh and Vijay Kumar [2014] [2] from Dept. of Electronics and Communication Indian Institute of Technology, Roorkee, India presented an approach for the swing up and stabilization of a rotary inverted pendulum (RIP). RIP system is an unstable, multivariable, under actuated and highly nonlinear in nature. RIP consists of a pivot arm; the pivot arm rotates in a horizontal plane by means of a servo motor. The opposite end of the arm is attached to the pendulum rod whose axis is along the radial direction of the motor. The task is to design a controller that swings up the pendulum, and keeps it in upright position. Swing up action is based on the energy principle whereas stabilization uses Takagi Sugeno Fuzzy controller. A mode controller is used to decide which control action is to be implemented. Mode controller is basically a condition check on the angle of the pendulum rod. Finally, MATLAB SIMULATION results reflect the performance of the RIP system with the stated control actions. R. Ortega [2013] [3] from Depto. deMatemática Aplicada, Universidad de Granada, 18071 - Granada, Spain presented the stability of the equilibrium of a pendulum of variable length in terms of the third approximation. In contrast, the traditional

linearization procedure is not always faithful. Alternative characterizations of stability are also presented. They are based on degree theory and on the algebraic structure of the symplectic group. V.P Mitrofanov1 and N.A Styazhkina [2013] [4] from Department of Physics, Moscow State University, 119899, Russia made a study of an external electric field influence on the pendulum damping. The electric field was applied between the conducting surface of the pendulum and the nearby electrode. The experiments were carried out in atmospheres with various values of relative humidity and in vacuum. The losses are found to be dependent on the surface-adsorbed water as well as the manner of surface treatment of both the pendulum and the electrode.

3. WORKING PRINCIPLE

The pump is made of pendulum, two-leg lever and cylinder with the piston which pumps the water. Oscillation of the pendulum is maintained by periodical action of the human arm. Oscillation period of the pendulum is twice bigger than the period of the lever oscillation. Piston of the pump has reverse effect on the lever and damps its oscillation. Damping of the lever motion causes damping of the pendulum, but the work of the force damping the pendulum is less than the work of the forces which damp the lever.
Equilibrium position of the lever is horizontal, and the equilibrium position of the pendulum is vertical. Oscillation of the lever and the pendulum takes place in the same plane, vertical in reference to the ground. Physical model of this type of water pump was shown at a number of exhibitions, in some publications.

4. PRINCIPAL COMPONENTS

4.1 Frame

It is the main part of the pump system and it is made up of steel. The cycle frame consists of seven rigid links which convert the pendulum movement to the piston movement.

4.2 Reciprocating Pump

This is a positive displacement pump. This is closely fitted with cylinder by the principle of actual displacement or a plunger.

4.3 Springs

Spring is an elastic object which store mechanical energy. Here, in this system both tension and compression springs are used. The function of tension and compression springs to stretch and compress according to load applied.

4.4 Weight Hanger

Weight hanger is used for holding the weight. It is also the oscillating part of the system; thus it acts as a pendulum.

5. FABRICATION OF PENDULUM BASED WATER PUMP SYSTEM

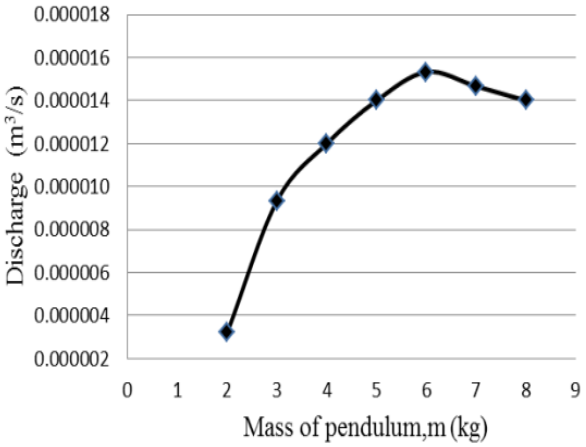
Steps of fabrication of pendulum based water pump is as follows:
1. Collecting the required raw materials.
2. Cutting the metal bars to required size.
3. Fabrication of frame as per the design by utilizing the metallic bars.
4. Fixing of reciprocating pump to the frame.
5. Placing the lever at the correct position.
6. And fabrication of pendulum to the lever end.

6. RESULTS AND ANALYSIS

The various parameters that determine the output discharge of the pendulum pump are analyzed and the results are plotted. Analysis parameters include mass of pendulum, swing angle, length of pendulum.

6.1. Analysis of Mass of the Pendulum

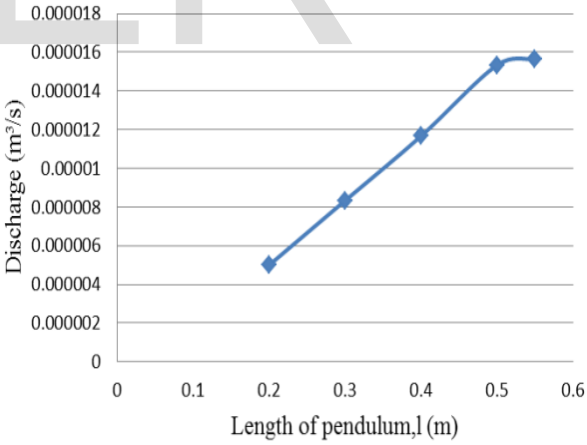
Here, the discharge is found out by changing the mass of the pendulum by maintaining the maximum swing angle and maximum length of the pendulum.



Graph 1 Mass of pendulum, (m) vs Discharge

6.2. Analysis of Swing Angle of the Pendulum

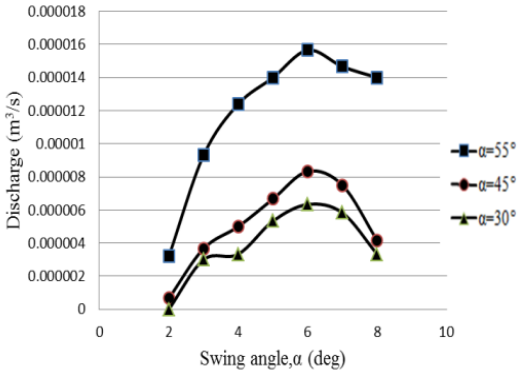
Here, the discharge is found out for various swing angles (30°, 45° and 55°) by changing the mass of pendulum without changing the length of the pendulum (0.55 m).



Graph 2 Swing angle (α) vs Discharge

6.3. Analysis of Length of the Pendulum

Here, the discharge is found out by varying the length of the pendulum without changing the mass of the pendulum and the swing angle.



Graph 3 Length of pendulum, (l) vs Discharge

7. CAD MODEL

8. APPLICATIONS

a) Drainage: Used to control the level of water in a protected area.
b) Sewage: Used in the collection and treatment of sewage.
c) Irrigation: Used to make dry lands agriculturally productive.
d) Chemical Industry: Used to transport fluids to and from various sites in the chemical plant. Petroleum Industry: Used in every phase of processing of petroleum, its transportation, and separation of the impurities.
e) Medical Field: Used to pump fluids in and out of the body.
f) Steel Mills: Cooling water in steel mills can be transported using a pendulum pump.

9. FUTURE SCOPE

a) It can be used where the shortage of power or electricity is a major issue.
b) From experimentation it can be concluded that the system is practically feasible.
c) Implementing a pendulum pump setup that uses gravitational force only
d) Implementing a pendulum pump setup which uses gravitational force only, leads to large amount of energy
e) This system is more efficient, considering the minimum efforts required.

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