Design and Fabrication of Pendulum Operated Hand Water Pump

Chethan B P[1], Gowrishankar P S[2], Karthik M[3], Manoj K M[4], Vishwanath K H[5]
[1, 2, 3, 4] Dept of Mechanical
[5]Assistant Professor, Dept of Mechanical
[1, 2, 3, 4, 5] REVA UNIVERSITY, Bengaluru

Abstract- *THE Scope of our project is to explain the solution for hand pump by saving the energy. It is easy enough to move pendulum with the hand instead to large swings where it saves the human effort. Due to pendulum oscillations the linear movement is obtained in the lever which is connected to the piston .So that the movement of piston from higher to lower head is pumping the water from the source (sump, ground). The water outlet is based on the vertical movement of lever caused by oscillation of pendulum.*

Keywords- SimplePendulum, Reciprocating Pump,Oscillations,

I. INTRODUCTION

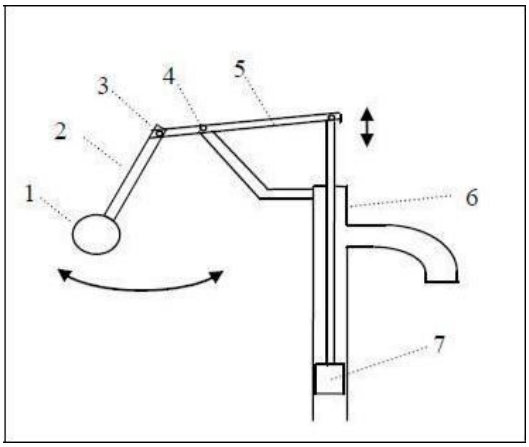
The ever increasing demand for energy has led to the formation of various advanced resources which produces a certain part of the required energy. One principal consumer of a large amount of energy is our household itself. Large amount of electrical energy is wasted in pumping water, irrigation purposes etc. It is in this context the importance of pendulum pump arises, by the use of which a large amount of energy can be conserved and the conserved energy can be used for various other purposes. Basically in villages and also in some town side areas, we could able to see the piston pumps which have been installed to suck the water from the ground, and this source of water from the ground is known as ground water. In pump the reciprocating motion is to be given by the people who access it. And by using that reciprocating motion, the suction is created and as a result water comes out from the ground. Hence no other method can easily replace it, due to its less maintenance, and easy accessibility. Hence it has been in the peak for several years. But we do not have the idea to replace those pumps. But we have the idea to reduce the human effort which is being given in these types of pumps. By saying particularly that, the reciprocating motion that is being given in the piston pump can be replaced by the oscillating motion obtained due to the oscillation of certain mass. New and technically original idea - hand water pump with a pendulum - provides alleviation of work, because it is enough to move the pendulum occasionally with a little finger to pump the water, instead of large swings. Using the minimum of human strength in comparison to present classic hand water pumps enables efficient application in irrigation of smaller lots, for water-wells and extinguishing fires even by old people and children. Hand water pump with a pendulum is a realization of a new, original, and even unbelievable, by very simple solution for pumping water. Work is alleviated because easier, long-lasting and effortless use of the hand water pump has been enabled. Input energy for starting the process of pumping, in form of occasional pushing of the pendulum, is much less than with typical 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. The pump works well with all sizes of the pendulum, but mainly with the amplitude of 90

II. IDENTIFY, RESEARCH AND COLLECT IDEA

The ever increasing demand for energy has led to the formation of various advanced resources which produces a certain part of the required energy. One principal consumer of a large amount of energy is our household itself. Large amount of electrical energy is wasted in pumping water, irrigation purposes etc. It is in this context the importance of pendulum pump arises, by the use of which a large amount of energy can be conserved and the conserved energy can be used for various other purposes.

Basically in villages and also in some town side areas, we could able to see the piston pumps which have been installed to suck the water from the ground, and this source of water from the ground is known as ground water. In pump the reciprocating motion is to be given by the people who access it. And by using that reciprocating motion, the suction is created and as a result water comes out from the ground. Hence no other method can easily replace it, due to its less maintenance, and easy accessibility. Hence it has been in the peak for several years. But we do not have the idea to replace those pumps. But we have the idea to reduce the human effort which is being given in these types of pumps. By saying

particularly that, the reciprocating motion that is being given in the piston pump can be replaced by the oscillating motion obtained due to the oscillation of certain mass. New and technically original idea - hand water pump with a pendulum - provides alleviation of work, because it is enough to move the pendulum occasionally with a little finger to pump the water, instead of large swings.



Schematic hand water pump with pendulum

1. Load of the pendulum
2. Handle of the pendulum
3. Axis of the pendulum
4. Axis of the two-leg lever
5. two-leg lever
6. Water pump
7. Piston of the pump

III. WRITE DOWN YOUR STUDIES AND FINDINGS

Pendulum specifications

1. Material = mild cast iron
2. Weight = 3.5 kg
3. Arm length =.35m

Pump specifications

1. Stroke length of the Pump (l) = 60mm
2. Diameter of the piston (d) = 76.2mm
3. Time Period (Tp) = 1.3s
4. SPEED OF THE PUMP

N = 60/Tp

N = 60/1.3 N = 45 strokes/min

Pump Calculations

1. SWEPT VOLUME

$V = \pi/4\ d^2\ l$

=0.0045603*.06

= .000273618m3

2. OUTPUT ENERGY OF PUMP (Eout)

Eout = m g H

Hs = suction head

m = mass of water,

Hd = delivery head

g = acceleration due to gravity,

H = total head

H= .5m

INPUT ENERGY TO THE PUMP

Ep= Input energy to the pendulum

T = Time period

Pout = Power output from the pendulum

r = Pendulum rod length

T s = 0.549 seconds

M= mass of pendulum

CASE 1 : Pendulum in initial position

Ep = m g r

= 3.5 × 9.81 × 0.035

= 1.201joules

Pout = (1.201/0.549)

= 2.187 watt (output power of pendulum is input to the pump)

ηmech = (Pout/ Pin)

= (1.287 / 2.187) = 58.84%

CASE 2 : If the pendulum angle is 60 deg with lever

Ep = 2m g r

= 2 × 3.5 × 9.81 × 0.035

= 2.4 Joules

Pout = (2.4/0.589) = 4.0747 Watt

ηmech = (1.289/4.0747) = 31.67%

CASE 3 : If the pendulum angle is 0 or 90deg with the lever

Ep = 3 m g r

= 3 × 3.5× 9.81 × 0.035

= 3.605 Joules

Pout = (3.605/0.589) = 6.1208Watt

ηmech = (1.289/6.1208) = 21.5%

Force Analysis of a Pendulum

There are two dominant forces acting upon a pendulum bob at all times during the course of its motion. There is the force of gravity that acts downward upon the bob. It results from the Earth's mass attracting the mass of the bob. And there is a tension force acting upward and towards the pivot point of the pendulum. The tension force results from the string pulling upon the bob of the pendulum. In our discussion, we will ignore the influence of air resistance - a third force that always opposes the motion of the bob as it swings to and fro. The air resistance force is relatively weak compared to the two dominant. The gravity force is highly predictable; it is always in the same direction (down) and always of the same magnitude - mass*9.8 m/s2. The tension force is considerably less predictable. Both its direction and its magnitude change as the bob swings to and fro. The direction of the tension force is always towards the pivot point. So as the bob swings to the left of its equilibrium position, the tension force is at an angle - directed upwards and to the right. And as the bob swings to the right of its equilibrium position, the tension is directed upwards and to the left

IV. CONCLUSION

On increasing the suction head, discharge of the given pendulum system decreases. On increasing the mass of pendulum, discharge of the given pendulum system increases. On increasing the angle of swing, the discharge of the given pendulum system increases. It was concluded that human effort is considerably reduced while pumping water by a pendulum operated pump compared to a regular pump.

REFERENCES

[1] Vexternal electric field influence on the pendulum damping in year 1999 volume 256 issued 5-6 page 351-355 .

[2] In the year 2014 Rahul Singh and Vijay Kumar 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).

[3] R.Vigithra ,V.Ajith ,B.R. Jaya Krishana, R.ajithkumar ,S.Dinesh presented an approach on Design and Fabrication of Pendulum Hand Water Pump in journal of Innovative Research and Development in Issue-2,2016,pp.71-75

[4] Anurag Anand , Devanshu Jhakal ,Rahul sharma , Rupesh Deshbharath presented an approach on fabrication of pendulum pump in international journal of scientific & engineering research ,volume 8, issue 2,2017.

[5] Rony K. Placid et al. in the research paper "FABRICATION AND ANALYSIS OF A PENDULUM PUMP"[1](April 2015) .

[6] P Mitrofanov and N.A Styazhkina from Department of Physics, Moscow State University, Russia made a study of an Akshaj Adhikari in the research paper "DESIGN AND FABRICATION OF HANDWATER PUMP WITH PENDULUM"