ENERGY CONVERSION PHENOMENON IN IMPLEMENTATION OF WATER LIFTING BY USING PENDULUM EFFECT

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ABSTRACT

This paper consist of working of reciprocating pump which is driven by a compound pendulum. It provides the energy required to lift the water from a tank placed approximately several meter below the ground level. Basic application of the mechanism will be for watering the garden which will be operated by means of operation opening and closing of entrance gate. Paper consists of basic concept, design of pump and compound pendulum mechanism and fabricationed model. The concept can also be implemented in the rural areas, having the problem of electric supply. We aim at making a prototype for providing some mean for pumping of water by the pump which requires less human efforts, considering cost effectiveness, easy to operate and portable mechanism.

KEYWORDS-compound pendulum, prototype, Reciprocating pump.

INTRODUCTION

Hand water pump with a pendulum is a very simple solution for pumping water. It 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. Work is alleviated because easier, long-lasting and effortless use of the hand water pump has been enabled.

Once input is provided to pendulum, it keeps on oscillating for some time, thus transferring the oscillatory energy into reciprocating motion. In the year 1999, Sir Veljko Milkovic invented same mechanism named as two-stage oscillator mechanism. The attraction of the mechanism was the amount of energy input provided to be less than the energy output. The statement was explained by carrying out various kinds of experiments. Nebojša Simin explained how to increase the input energy by operation of the pendulum-lever system [1]. Sir Jovan Bebic and Lujbo Panic gives relation between output and input energy of the system and found that the system is more efficient greater than unity [2, 4].The logic of this theory was also used to explain the pendulum operated pump of Veljko Milkovic and to improve its behavior by applying some efficient effort.

The hand pumps are manually operated pumps, they use human power and mechanical advantage to move fluids or air from one place to another. There are many different types of hand pump available, mainly operating on a piston, diaphragm or rotary vane principle with a check valve on the entry and exit ports to the chamber operating in opposite directions. Most of the hand pumps have plungers or reciprocating pistons, and are positive displacement. Thus by considering all conventional advantages we decided to use water operated pump with more efficient working which can be used in various purpose.

CONCEPT

The concept behind this prototype is to lift the water with the help of pendulum, which is attached to the fulcrum. The pump used in this prototype converts the oscillatory motion into the reciprocating motion, and henceforth lifts up the water upto the desired level.
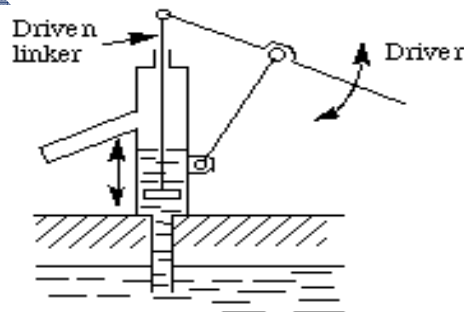

Fig.1- Driving mechanism

The parts of Pendulum based water pump are:
1. Load of the pendulum,
2. Handle of the pendulum,
3. Axis of the pendulum,
4. Water pump,

5. Piston of the pump

The pump is made of pendulum, 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. 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.

Gravity effect:

The gravity effect can be created by using rotation and inertia.In this, the pendulum represents the gravity shield, such that its energy varies from horizontal to vertical axis. The work done by total vertical force acting at pivot point of the pendulum when the pendulum is at vertical axis is passed to the left side of the lever and this work is used to increase potential energy of mass on the other side of the lever as it goes in upward direction.

Energy analysis:

As we make an effort to associate the motion characteristics described above with the concepts of kinetic energy, potential energy and total mechanical energy. The kinetic energy possessed by an object is the energy it possesses due to its motion. It is a quantity that depends upon both mass and speed. The equation that relates kinetic energy (KE) to mass (m) and speed (v) is,

$$KE = 1/2 \ mv^2$$

Two types of potential energy are discussed in The Physics Classroom Tutorial - gravitational potential energy and elastic potential energy. Elastic potential energy is only present when a spring (or other elastic medium) is compressed or stretched. The amount of gravitational potential energy is dependent upon the mass (m) of the object and the height (h) of the object. The equation for gravitational potential energy (PE) is,

$$PE = mgh$$

Where g represents the gravitational field strength (sometimes referred to as the acceleration caused by gravity) and has the value of 9.8 m/s^2.The height of an object is expressed relative to some arbitrarily assigned zero level. As the pendulum bob does the back and forth, there are times during which the bob is moving away from the equilibrium position.

CONSTRUCTION AND WORKING:

A. **Design of system:**

The working of prototype is basically dependent upon the pendulum and pump system. Hence, at starting, we aimed to make the supporting structure of these elements, i.e., frame. Later on, we concentrated on the design of the vital parts of the prototype,viz.,pump, pendulum, lever system, etc.

B. **Design of Reciprocating Pump:**

The design of the system is considered with the suction head of 15 meter. Power required by pump can be given by the equation:

$$P= \{\varrho gAN(H_g+H_d)L\}/60 \ watt$$

Where,ϱ is the density of water, A is the cross-sectional area of reciprocating pump (m^2),N is the speed of reciprocating pump (strokes/min), Hs is the suction head (m),Hd is the delivery head (m), L is the length of stroke (m).
For the reciprocating pump, energy is given by,

$$E_{out}=g\varrho A(H_s+H_d)L \ Joule$$

Pumps can produce any head according to the force that is impressed on it. The maximum head is given by the power available and the strength of the pump with parts consist of plunger and connecting rod.Assuming diameter of pump as 20 mm and length of stroke as 50 mm.

Speed of the pump,

$$N=(60/T_p)$$

Swept Volume,

$$v=Al$$

Discharge,

$$Q = Nv$$

Minimum thickness of cylinder,

$$t=(PD)/2\sigma$$

C. **Design of pendulum** :

When the pendulum is allowed to drop downwards, it keeps losing its potential energy, but it gains velocity and in that way it transforms potential energy into kinetic energy. When a body is moving along a curved path, it is subject to both, centripetal and centrifugal force. They have the same intensity but in the opposite directions. In practice, the tension force and the reaction acting on the pivot are the same forces, but we will use only force T. The formula for the tension force in the pendulum rod, with fixed pivot point, is shown below:

$$T = Mg \ (3\cos(\varphi) - 2\cos(\varphi o)),N \qquad (1)$$

Where, φo is the angle of initial position 1, and φ is the angle from a vertical line i.e. from the low position 3 and towards position 1.

Because the pivot point can move only vertically, only the vertical component of the tension force Ty commits the work. That component will also decrease with the increase of the angle φ, independently from the decrease of tension force T. The formula for the vertical component of the tension force is:

$$Ty = T \cos(\varphi) = Mg (3\cos(\varphi) - 2\cos(\varphi o)) \cos(\varphi) \qquad (2)$$

WORKING:

The working principle of the water pump with a pendulum: oscillation of the physical pendulum (1) is maintained with a minimum engaging hand. A variation of inertial forces causes the oscillation of two-armed lever (2), which is associated with a piston pump (3), and there is a spring (4). 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.

Hand water pump with a pendulum for pumping water out from wells or reservoirs consists of a cylinder (1) with a piston (2), lever system (3), a seesaw (4), a pendulum (5), a reservoir (6) and output water pipe (7).Initially, the pendulum is at rest. When we supply the mechanical energy to it through hand or other means, it starts oscillating about its mean position, according to the Newton's second law of motion.
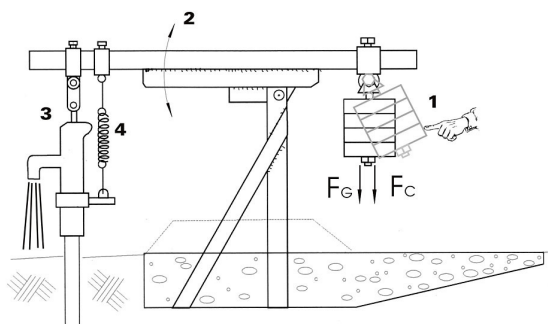

Fig.3-Working Model

As the pendulum is attached to the fulcrum perpendicularly, its oscillating motion is converted into the reciprocating motion of fulcrum. Later, this reciprocating motion of fulcrum is damped by springs, which are attached to the base and fulcrum. This damping motion of springs provides reciprocating motion to the pump and hence lifts up the water.

ADVANTAGES

The main advantage of hand water pump is to avoid human strain. It also helps us for the easy way for pumping water. The cost required to implement this is comparatively low Hand water pump with is more efficient when compared to normal hand water pump as the water flow is high. The main advantage of this pump is that they are one of most economical and simple solution for providing collective supply of drinking water

LIMITATIONS

The main limitation is the reciprocating pump initially needs priming so it lifts water at desired level. As the design is simple the links are simple and long hence system becomes bulky. A pump requires regular maintenance which must be carried out if pump is to be use on a sustainable basis.

APPLICATIONS

Water pump with pendulum can be widely used in rural areas. As the installation cost of water pump with pendulum is low it is useful for poor people. It can be installed in all the public places. It can be operated by children or old people as the force required by the pump is low.

CONCLUSION AND DISCUSSION

The free energy of the machine based on oscillation of the pendulum-lever system, is defined in this study, as a difference between the output energy of the machine and the energy input from the environment. Existing free energy defined in this way is not in accordance with the energy conservation law, but it has been verified experimentally and it can be explained and proven.

The system takes its energy from available surrounding i.e. gravity. So if, along with the input energy, the energy from surrounding is also considered, then the efficiency of the system is less than 100 % and if only input is considered then its efficiency would be greater than 100 % for a certain time. If the pendulum motion is kept by giving some external media then the energy is transfer through pivoted joint of lever towards pump shaft. In this way we conclude the energy flow of system.

RESULT

The main parameters were the amount of energy, required to be given to the pendulum and the discharge obtained from the pump. Along with this, the other parameters were also checked and compared with the designed values as per Table.

Also results shows that the change in design and weight in pendulum can change the head and pump efficiency. And, we can get different results by varying the height of the pendulum.

TABLE I

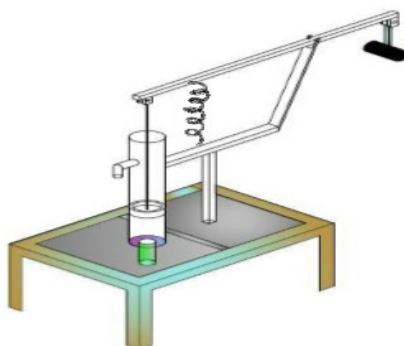| Parameter	Designed parts	Actual parts
Pendulum pivot	Bearing attached	Nut and bolt attached
Length of pendulum rod	Extend to 15"	4"with rectangular section
Motion suspension	Modify with spring length of 15"	No such system provided
Speed	45 stroke/min	30 stroke/min

Fig.4-3D model

Fig.5-Fabricated Model

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