

DEVELOPMENT OF A DEVICE TO GENERATE POWER FROM BEEF COCK WATER

Md. Al- Amin^{1,*}, Syed Tanvir Faisal², Masud Rana³, S. C. Banik⁴
and Md. Romel Chowdhury Dipu⁵

¹⁻⁵Department of Mechanical Engineering, CUET, Bangladesh

^{1,*}cuetianalamin0903091@gmail.com, ²postcsrdshown@gmail.com, ⁴sajolbanik@cuet.ac.bd,
⁴rumel2296804@gmail.com

Abstract- Using the renewable sources of energy is one of the recognized ways to save energy. So Engineers are always keen to find out ways to use the renewable source of energy. Water is a key source of renewable energy. Water that is used in household activities can be used to generate electricity. Household water comes through beef cock (which is formally known as tab). The velocity of the water in beef cock is enough to produce a decent amount of electricity. The system described in this paper use this water velocity to rotate turbine and produce electricity. A rectangular shape box having an inlet and outlet is used here. It has a set of pinions to set speed ratio. A shaft is attached to the small pinion. The coils with the shaft are imposed in permanent magnetic field. There is a water turbine with hemispherical van. The water is impinged on the van perpendicularly. The more rpm is produced in the shaft the more flux will be cut. The more the flux will cut the more the power will be generated. The system has an energy reservation unit to reserve the power.

Keywords: Beef cock, Turbine, Magnetic field, Gear- pinion, Hemispherical van.

1. INTRODUCTION

Huge amount of water is used in household activities that come through beef cock (commonly known as water tap (see Fig: 1)).The velocity in beef cock is enough to produce a decent amount of electricity that can be stored and used. The velocity of water exerted from beef cock is used to rotate turbine and gear system is used to increase velocity. The gear shaft is inserted into magnetic field and thus produces electricity. This electricity is then stored in a battery for further use.

Bangladesh's installed electric generation capacity was 8525 MW in 2013, only three-fourth of which is considered to be 'available'. Only 40% of the population has access to electricity with a per capita availability of 136 kWh per annum [1].

The per capita energy consumption in Bangladesh is only 136 KWH [1]. Therefore, electricity crisis is huge in Bangladesh. The renewable energy can be a good solution to compensate this problem. Solar energy is the mostly

used renewable energy in Bangladesh. But considering the cost of setting up a solar panel, it is not popularly used in our country. Water is the source of renewable energy. This device can produce some additional amount of electricity that partially overcome the electricity problem

To implement this in any building, it is not needed to change the internal design of the building or the water system exists there. It just needs an external modification. So every power company should come forward to help us to industrialize this and to help to overcome some portion of the electricity crisis of Bangladesh.

2. SYSTEM DESIGN

2.1 Beef Cock

Beef cock is a device that exerts water which is used in household purposes (see Fig: 1). Beef cock is made from metal or plastic.



Fig. 1: Beef cock [2]

2.2 Gear and Gear ratio

The ratio between driver gear teeth and driven gear teeth is known as gear ratio. A system that allows the driver to switch between gears would improve the situation yet further by allowing the driver to choose a gear ratio appropriate to the situation (low gear for starting from a standstill and travelling up an incline, high gear when the speed rises) [3]

2.3 High gear

The high gear (Fig 2) has 100 mm diameter or addendum circle, 95 mm pitch circle, 85 mm dedendum circle and 80 mm base circle. It has twelve teeth and the angle between every tooth is 30 degree.

The low gear has 33.33 mm diameter or addendum circle, 28 mm pitch circle, 23 mm dedendum circle and 20 mm base circle. It has six teeth and the angle between every tooth is 60 degree. (see Fig: 3)

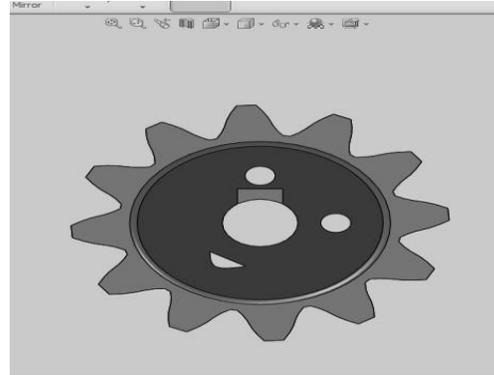
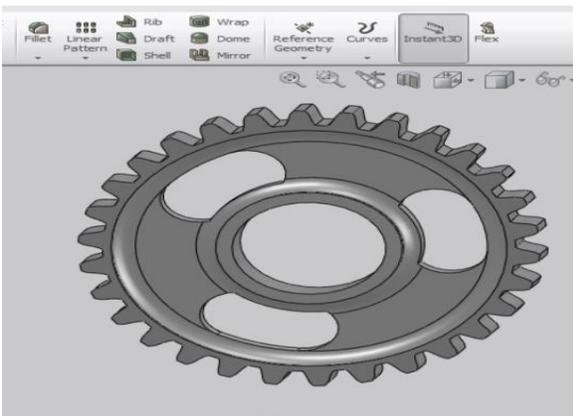


Fig 3: Low gear

2.5 Impulse Turbine

The Impulse turbine (as in Fig 4) is made of stainless steel. It works through momentum changing of water. The designed vane is like as a cup so that the water can strike vertically to it. It is placed horizontally with the inlet.

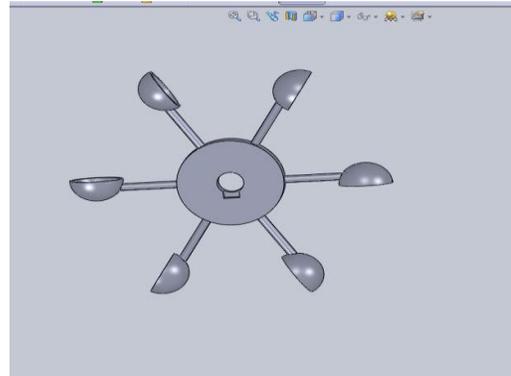


Fig 4: Turbine

In the way revolution can be gotten from turbine and finally voltage can be gained due to cut off flux of magnet.

2.6 Magnetic field

A magnetic field is mounted on the box, near to the outlet.

2.7 Shaft

A shaft of 82 mm long and 20mm in diameter is used. The shaft is made of aluminum. There are two keys which tie the turbine and gears. The shaft is exposed into the magnetic field (Fig. 5)

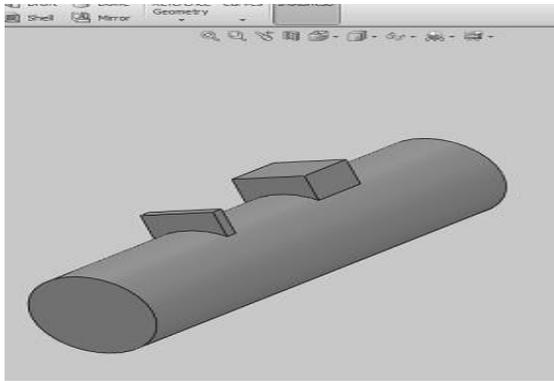


Figure 5: Shaft

2.8 Combined Structure

The full set up combining the parts described above is given below.

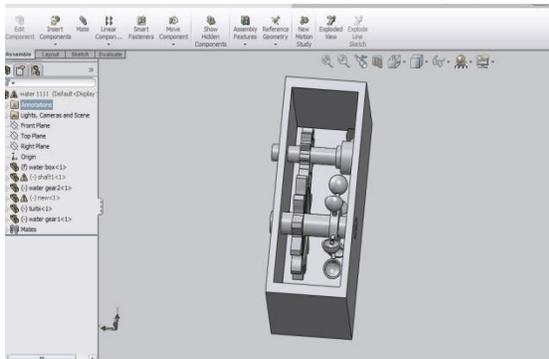


Fig 6: The full set up

In the Fig. 6, it can be seen that there is an outlet in the backward side of the figure. The turbine is attached to the high gear shaft. The high gear is mated with the low gear. The turbine is perpendicular to the flow of fluid and parallel to the high gear. The flow of fluid strikes the turbine through inlet and it gets the high gear regulated. The low gear regulates 3 times than the high gear as it is mated up with the high gear. The coil of magnetic field is attached with the shaft of low gear. The coil cuts magnetic flux as it regulates with the shaft.

3. POWER ASSIST OVERVIEW

To get the full set up it is needed to have some manipulated data. Here, the manipulated data that is got from impulse turbine is discussed below.

3.1 Power Produced by the Impulse turbine

If the quantity of water in kN, flowing through the inlet per second, and the amount of work

done per second is known then the power produced by the turbine may be found out with the help of velocity triangles as usual. The power produced may also be found out from the relation,

$$P = wQH [4]$$

$$= 9.81 \times 10 \times 0.12$$

$$= 1.2 \text{ kW}$$

Similarly the other values of Q can be obtained.

3.2 Mechanical Efficiency

It has been observed that all the energy supplied to the turbine doesn't come out as useful work. A part of it is dissipated in overcoming friction of bearing and other moving parts. Thus the mechanical efficiency is the ratio of actual work available at the turbine to the energy imparted to the high gear. [5]

3.3 Overall efficiency

It is a measure of the performance of a turbine and is the ratio of actual power produced by the turbine to the energy actually supplied by the turbine i.e

$$\eta = P/wQH [6] = 800/1200 = 0.666 = 66\%$$

3.4 Flow rate vs. Force Diagram

Q	0	10	16
F	0	22	30

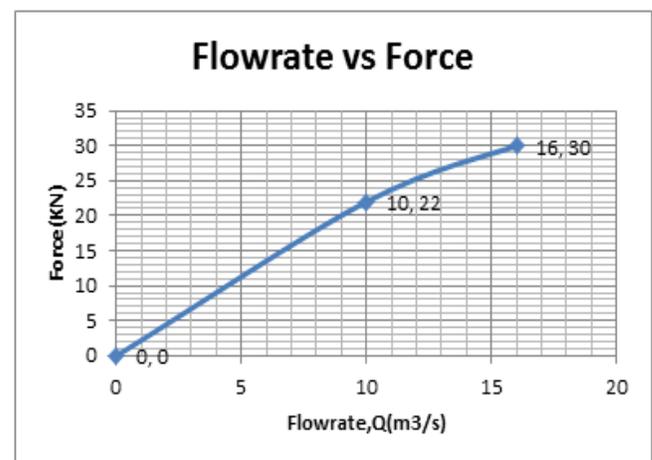


Fig. 7: Relation between Flow rate & Force

3.5 R.P.M vs Force Diagram

R.P.M	0	42	90
F	0	22	30

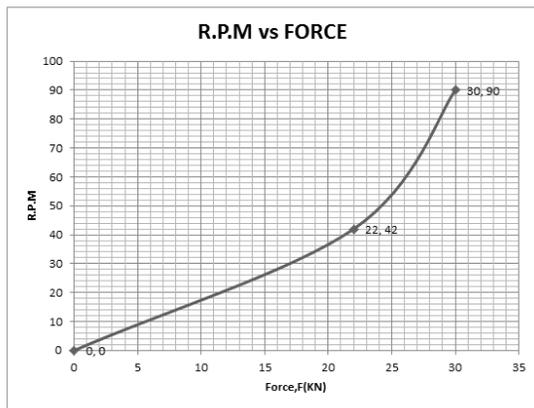


Fig. 8: Relation between RPM & Force

3.6 R.P.M vs Voltage Diagram

R.P.M	0	42	90
V	0	64	142

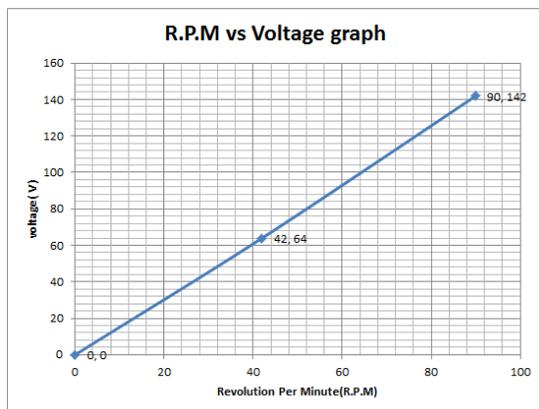


Fig. 9: Relation between RPM & Voltage

4. EXPERIMENTAL SETUP AND FABRICATION

4.1 The rectangular shape box

At first the rectangular shape box (Fig 10) is made at mechanical workshop CUET using wood. The exact box that we designed in SolidWorks cannot be used

for the insufficient material support. The box used for the experiment was 24 cm in length, 24 cm in width and 11.5 cm in height. The high gear and low gear is placed in support of shaft and mashed them up as required. The impulse turbine is placed with the high gear shaft.



Fig. 10: the rectangular Shape Box

4.2 The Inlet and outlet

Using the drilling machine in mechanical workshop, CUET the inlet and out let of the box is made. The inlet was perpendicular to the turbine and the turbine was parallel to the high gear.

4.3 The test set up

A water tap is needed where water flow can be obtained to rotate the turbine. In addition to admit that for inlet and outlet normal pipe is used which was easy to find out. (Fig: 11)



Fig 11: The complete experimental device

To testify whether electricity is generated or not, a 12 volt dc motor is used and connected to the device. As the water begins to flow the motor starts to rotate (as in Fig. 12). Here in the picture shows the motor is running from the electricity that was obtained from the device.



Fig. 12: The 12 volt dc motor is running with the power we are getting from our device

5. CONCLUSION

Finally, a device is designed to compensate the electricity which works by water velocity. It is assumed that this device will reduce our hampering from electricity. The device is designed carefully to make efficient and useable. The output power will increase by adding nozzle to water tap.

6. REFERENCES

1. http://en.wikipedia.org/wiki/Electricity_sector_in_Bangladesh
2. <http://www.publicdomainpictures.net/view-image.php?image=2779>
3. J. E. Shigley, C. R Mischke, R. G Budynas and K. J Nisbett, "Mechanical Engineering Design", Eighth Edition, pp.666-667, 2008
4. R.S. Khurmi, "Hydraulics, Fluid Mechanics and Hydraulics Mechanics", 2007 Edition, pp.512, 2007
5. Dr. A. K. Jain, "Fluid Mechanics", Eight Edition, pp.823, 2008

7 NOMENCLATURE

Symbol	Meaning	Unit
p	Power	W
w	Specific weight	KN/m ²
Q	Flow rate	Kg/m ³
H	Water head	m
α	Specific weight	KN/m ²
η	Efficiency	-