Exploring Opportunities for Hydro Power Generations with Heron's Fountain

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Abstract : Standalone small (Pico Hydro and Micro Hydro) hydro power generation have started gaining popularity in remote areas. These generations require small water head and are much more compact. They also allow use of various types of generators and turbines. The only dependency is availability of continuous water head for their operation. In conventional hydro power generation, water reservoir is constructed to ensure continuous water supply. However, the water coming out of such hydro power generating stations is hardly recycled i.e. fed back to the reservoir and used for power generation over and over again. Hydraulic Ram pumps are often being used now days to make an efficient system. In addition to this, section of appropriate turbine plays important role in power conversion. Power, Water head, portability, reliability, maintenance, flow rate, civil works are some of the factors influencing selection of turbine.

A Perpetual Motion Machine would be the ultimate requirement for best use of water resources available across the globe. Heron's Fountain is a near solution for construction a near Perpetual Motion Machine for maintaining a continuous water head. Suitable turbine and generator selection shall be a challenge for constructing a small Hydro Power Generation based on Heron's Fountain. This paper explores opportunities in hydropower generation with Heron's Fountain, its construction and future challenges.

Keywords: Heron's Fountain, Hydro Power Generation, Turbines, Hydraulic Ram.

I. INTRODUCTION

In recent years, energy consumption has been increasing at a relatively fast rate due to population growth and economic development. Rapid urbanization and improving standards of living for millions of Indian households, the demand is likely to grow significantly. In order to sustain the production, industries have opted for inefficient diesel-fuelled backup power. India's energy planning, which is based on the twin objectives of high economic growth and providing electricity to all, is failing to meet either. To cater the demands, a gradual shift towards renewable energy is being seen.

The construction elements of a typical hydro power plant being water reservoir or water stream, turbine and alternator; it is the alternator on which a lot of research is carried over the years. Different types of alternators, induction generators and their control schemes have been proposed, worked out and implemented by various researchers. Also some researchers have contributed towards the development of efficient turbines for selected site. But there has been a very little research on construction of alternative arrangements for supply of water for hydropower generation.

Heron of Alexandria designed a fountain which worked without any external forces and just with three water containers and connecting tubes. The system can pump out the water by the inner forces and the pressure of the water in the system. A re-circulating type of modified Heron's Fountain with Hydro RAMP pump is proposed in this paper which can recycle water used for hydro power generation.

II. LITERATURE SURVEY

The local electric power generation is necessary to promote progress of the localities especially on those hard to reach communities. Pico-hydro plants can be installed at such places to power one or few homes. The power requirement at such location is minimal during off periods which can be utilized for charging batteries and other electronic gadgets. In relation to rural development the simplicity and low relative cost of micro hydro systems open up new opportunities for some isolated communities in need of electricity. Use of such systems leads to spur economic growth [2].

Heron's fountain has been described by Heron of Alexandria in his treatise "The Pneumatics". In antiquity, scientists didn't state physical principles governing fluid motion as we do now, but they understood how things worked. Working as the original fountain (Heron's fountain) is particularly eye-catching. Such a demonstration of the principle of non-isothermal flow in looped pipe networks can be of great use to researchers focused on a physical principle and its different applications [1, 3].

A Greek mathematician Heron of Alexandria invented mechanical devices powered by air, water and steam which were used for a variety of reasons. He used his inventions for educational purposes and taught pneumatic principles by how his devices

worked. Heron's Fountain is an apparatus which responds when liquid water is added to the fountain basin and generates a water jet from the fountain head. This instrument operates using pneumatic principles and the principles of non-isothermal flow [5].

Pneumatic systems are commonly found in dams, transmission systems and power stations. Heron's Fountain is a device used to teach and demonstrate the principles of hydraulics with water and air pressure. Many scientists have dreams of perpetual motion machines that do not dissipate energy. This fountain is not continuous and therefore it is not perpetual since it only works for a certain amount of time until the velocity becomes zero [6].

Heron's fountain has a low water head and hence turbine selection becomes a key for electrical power generation here. Low head propeller turbine technology was determined to be the most suitable option based on several merits including improved access, ease of manufacture, portability, low cost, and reduced system complexity. In general, water turbine can be classified into two types; namely impulse turbine and reaction turbine. Most of the impulse turbines are suitable for high head and medium head with low flow site. In contrast, a reaction turbine is used for low head and ultra low head sites with high flow water, without taking into consideration whether it is horizontal or vertical arrangement [7].

Impulse Turbine is axial flow and it is declared as impulse turbine because the occurrence of a direct drive or impulse on the blades which creates by the water. It is operates in open environment with driven by one or more high-velocity jets of water which produce by the nozzle and impinge on the buckets. In the nozzle, pressure head was converted into kinetic energy where the pressure change occurred. The momentum of water that hitting the turbine runners will entirely produced a power of impulse turbine for drive the generator's shaft. Although Pelton, Turgo and Cross flow turbines are choices available, pelton turbine is commonly employed due to its suitability for a small scale hydro power system. Figure 1 shows types of impulse turbines.

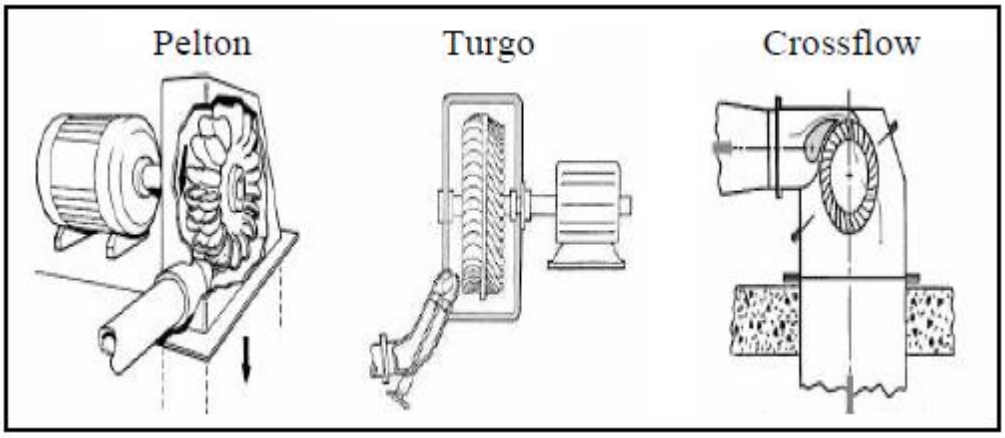

Figure 1: types of impulse turbine

Selection of turbine is very important in the design and development of a hydro power system. Factors need to be considered in selecting a turbine are on the specific head, maximum head, head variation, load variation, efficiency of turbines for various load, discharge availability and power house on the available head pressure, speed range and power capacity of alternator to be used [8].

III. PROPOSED SYSTEM & PROTOTYPE BUILDING

This project work focuses on building a free energy generator or a near Perpetual Motion Machine. The hardware prototype model can be divided into two parts, wherein first part is to generate a continuous water head with the help of Heron's Fountain. Figure 2 shows Heron's fountain.

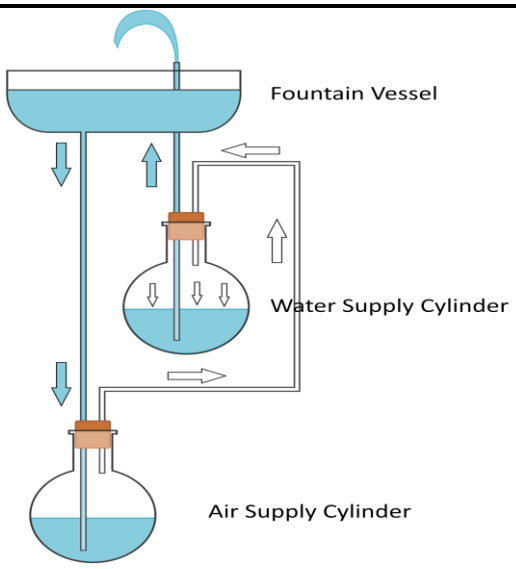

Figure 2: Heron's Fountain

The second part is obvious, to use this water head to generate electricity. This part will be based on water flow rate of the Heron's Fountain and involves comparative study of turbines for Hydro Power Generation and selection of the appropriate. Also, this model is build for standalone operation. Hence a battery charging unit will assist to store electrical energy. Figure 3 shows the block diagram of proposed hydropower generation system with Heron's Fountain.

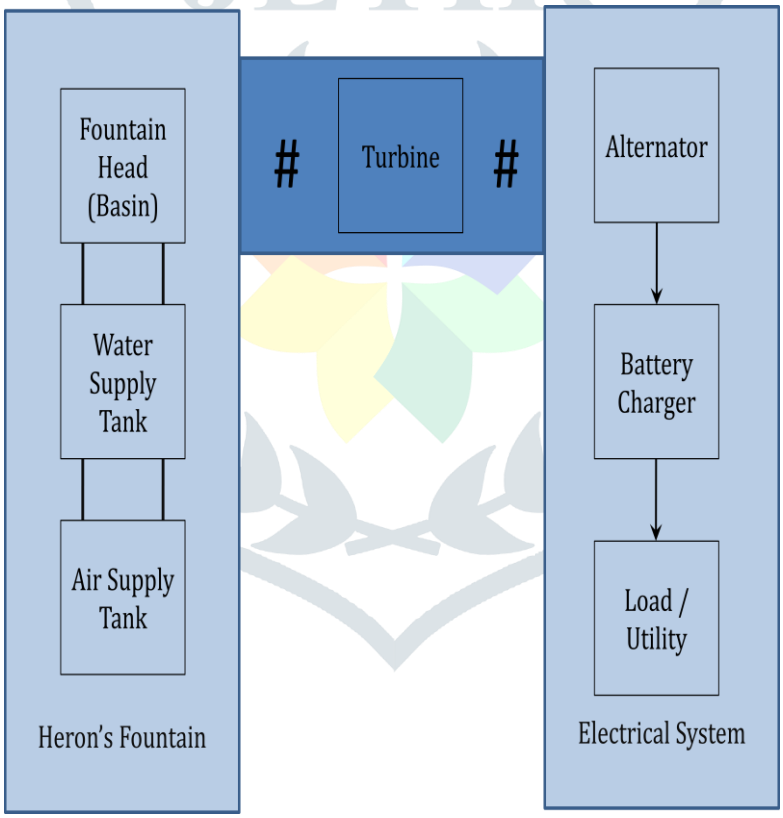

Figure 3: Block diagram of Hydropower Generation with Heron's Fountain

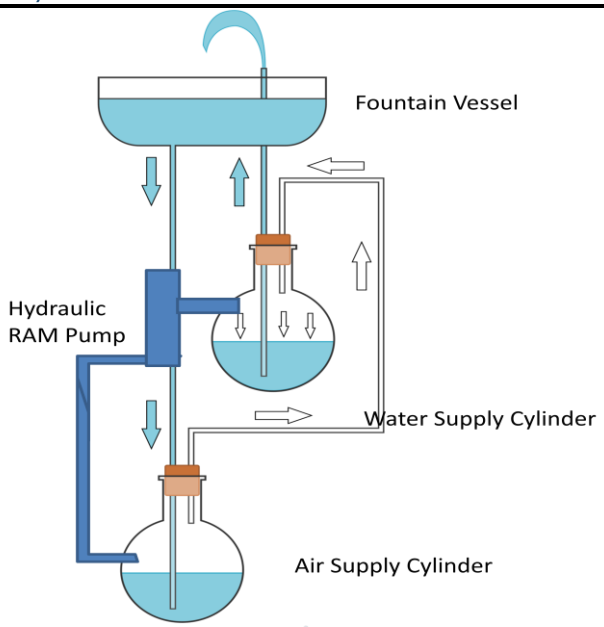

Figure 4: Modified Herons' Fountain

Figure 4 shows the proposed modification in conventional Heron's Fountain which involves introduction of a Hydraulic Ram Pump between fountain vessel and air supply cylinders. This Ram Pump pumps considerable amount of water directly into water supply cylinder and thus makes it to operate in closed loop manner. Although not all water is transferred into water supply cylinder, still 15 – 20% of water recharging is achievable with setup. A prototype modified Heron Fountain is built with 40 Liter/ minute water circulating capacity wherein, 5.5 Liter of water was circulated back to the water supply cylinder with RAM Pump.

IV. CONCLUSION

The comprehensive study reveals the possibility of generation of small electrical power with Heron's Fountain. The modified Heron's Fountain was built and tested for re-circulating functionality testing and it was observed that 15% of water can be pumped back to the generation system with such arrangement. A more sophisticated design will surely reduce the size of Hydro Power Generation system. Also the Opportunities for Hybrid Hydro Power Generation can be explored by combining it with Solar Systems.

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