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Archimedean Screw Power Generation

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Abstract

To design a prototype of screw turbine for power generation using principles of velocity vector. The conception of a screw turbine rotor for remote area electricity production. It has a great potential to be used for remote area to generated power by using low head water source as this research is developed. Energy crisis around the world encourage researcher to pay attention in founding alternate sources of green energy these days. A lot of research has been conducted by using natural energy sources such as solar, wind, wave and water. According to sources of energy from water to run a turbine, there is a rapid change of technology in using such turbine which suitable for definite kind of flow river, much of them are used for high head (differences) to produce electricity.

Micro-hydro power plant based on Archimedes Screw turbine is a type of renewable energy power plant is, easy to be functioned and operates on low costs, etc. The micro-hydro project designed to be a run-of-river type, because it requires no reservoir in order to power the turbine. The water will run straight through the turbine and back into the river or stream to use it for the other purposes. This has a minimal environmental impact on the local ecosystem. The choice of the turbine type depends mainly on the site head and flow rate. The turbine power and speed were directly proportional with the site head, but there were specific points for maximum turbine power and speed with the variation of the site water flow rate. The turbine efficiency could range from 80 to 95 percent and the generator efficiency about 90 percent.

Keywords— *Archimedean screw, micro hydro power plant*.

I. INTRODUCTION

Micro hydropower is an eco-friendly, fish-friendly, non-polluting renewable source of energy. It is the oldest renewable energy method used for production of electricity known to mankind mechanically. According to Kyoto protocol of 1997, most of industrialized countries agreed to set some emission reduction target in order to maintain environmental & climatic equilibrium of the world exposed by greenhouse effect, ozone depletion etc. To overcome these problems, renewable energy can be utilized to meet those international targets. In current scenario, India is blessed with half a million locations where water mills are serving for centuries. Under the Prime Minister's "Reconstruction Plan for J&K", it was decided to set up 1000 micro hydro projects in Jammu & Kashmir. A total of 948 micro hydro projects of 3-5 KW each have been installed in Jammu & Kashmir. Of these 550 projects are in Kashmir region, 339 in Jammu region and 59 in Ladakh region. If micro hydro power plants are installed there, an energy equivalent of 15000MW can be generated & 20 million Indians may get employed. There are nearly 5lac (approx.) potential sites over the entire Himalayan region from Jammu & Kashmir to north eastern states and can generate power as much as of 25000 MW i.e. each can generate at least 5KW. Till date only 25% (approx.) of the total hydro power potential has been tapped to generate power. Water mills are enough to run TV, refrigerator, cooler, fan & light bulbs etc. Small scale hydropower constitutes a cost-effective technology for rural areas in developing countries and, on the other hand, is a quiet growing sector in India. In the last decade, problems related to energy crisis such as oil crisis, climate change, electrical demand and restrictions of whole-sale markets have risen world-wide. These difficulties are continuously increasing, which suggest the need of technological alternatives to assure

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their solution. One of these technological alternatives is generating electricity as near as possible of the consumption site, using the renewable energy sources, that do not cause environmental pollutions, such as wind, solar, tidal and micro hydro-electric power plants.

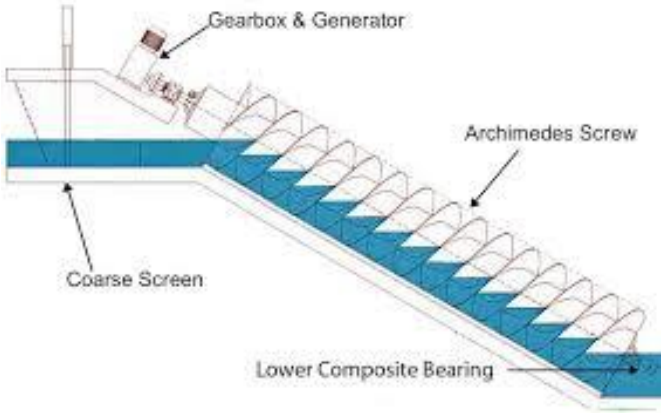

Fig. no. 1.1. Archimedean power screw

Micro Hydro Power Plant.

The first hydroelectric scheme was installed in Wisconsin in 1882; three years after Thomas Edison invented the light bulb. Soon after, hydropower became an important resource for electricity generation. 20% of total electricity consumed worldwide comes from hydro electrical plants. In some countries, hydropower supplies 80% of electricity. This has generally been supplied by larger hydroelectric plants. Interest in small hydropower plants declined due to the success of these large hydropower, nuclear and diesel power-plants. However, concern about climate change, air quality and increasing costs of fossil-fuel based generation has renewed interest in small hydro and other renewable forms of generation. The use of falling water as a source of energy is known for a long time. In the ancient times waterwheels were used already, but only at the beginning of the nineteenth century with the invention of the hydro turbine the use of hydropower got a new impulse. Small-scale hydropower was the most common way of electricity generating in the early 20th century. For example, in 1924, Switzerland had nearly 7000 small-scale hydropower stations which were in use. Micro hydro plants that are found are mostly in mountainous regions such as Himalayas, Andes including both mechanical and electrical power generation.

II. WORKING

The screw turbine is a water turbine which uses the principle of the Archimedean screw to convert the potential energy of water on an upstream level into kinetic energy. It may be compared to the water wheel, though the screw turbine has a much higher efficiency. The turbine consists of a rotor in the shape of an Archimedean screw which rotates in a semi-circular trough. Water flows into the turbine and its weights presses down onto the blades of the turbine, which in turn forces the turbine to turn. Water flows freely off the end of the turbine into the river. The upper end of the screw is connected to a generator through a gearbox. The Archimedean screw turbine is applied on rivers with a relatively low head (from 1 m to 10 m) and on low flows (up to around 10 m3/s on one turbine).

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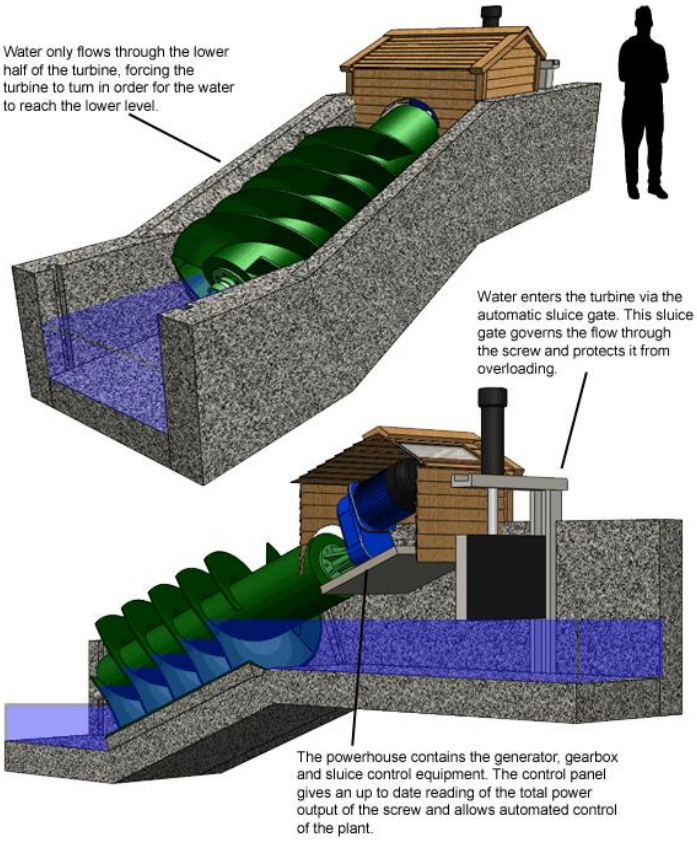

Fig. no. 2.1. Working of plant

Due to its construction and slow movement of the blades, the turbine is considered to be friendly to aquatic wildlife. It is often labelled as "fish friendly". The Archimedean turbine may be used in situations where there is a stipulation for the preservation and care of the environment and wildlife. The low rotational speed and large flow-passage dimensions of Archimedean screws also allow fish to pass downstream through the screw safely. The final advantage of the Archimedean screw is simplified engineering works and foundation. Archimedean screw doesn't have draft tubes or discharge sumps, it means that the depth of any concrete works on the downstream-side of the screw is relatively shallow, which reduces construction costs.

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TABLE I
TURBINE CLASSIFICATION

PARAMETERS	SCREW TURBINE	KAPLAN TURBINE	FRANCIS TURBINE
EFFICIENCY	UPTO 90%. REMAINS CONSTANT WITH VARYING LOAD.	ABOVE 90%. COMES DOWN DRASTICALLY AT VARYING LOAD.	ABOVE 85%. COMES DOWN AT VARYING LOAD.
GENERATION CAPACITY	500KW	UP TO 5MW	UP TO 1000MW
HEAD	1M TO 10M	2M TO 50M	30M TO 800M
DISCHARGE	0.2 TO $10M^3/S$	3 TO 30 M^3/S	0.2 TO $10M^3/S$
WEAR AND TEAR	NEGLIGIBLE	VERY HIGH	VERY HIGH
MAINTENANCE	NEGLIGIBLE	REGULAR	REGULAR
ENVIRONMENT FRIENDLY	YES	NO	NO

III. FUTURE SCOPE

- Compact Model, Better space management.
- Impact of varying parameters including slope and pitch can be investigated.
- Water outlet can be added at the center of screw to determine power generation, as the centre has highest velocity due to kinetic energy.

IV. ACKNOWLEDGMENT

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