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Power Generation by using Irrigation Canal Water

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Abstract: This Project is all about developing an equipment to utilize the irrigation or agricultural water from the canals to produce electricity. Electricity forms the backbone & basic necessity of a poor farmer. Hydropower is the cheapest way to generate electricity today. No other energy source, renewable and non-renewable, can match it. In the developing nation like India, with the increase in population and rise in the usage of electricity is increasing at an alarming rate. The following paper gives an idea about efficient use of water wheels in an open channel flow which gives cheap, low scale power generation solution for simple electrification purpose. This is achieved by a horizontal axis waterwheel attached to a Dynamometer, converts mechanical energy into electrical energy, with the help of a belt and pulley arrangement. The full bridge rectifier allows for electricity to be transmitted in its most efficient form while still being able to power ordinary direct current into pure direct current. Regulator to regulate a current and a battery to store it.

Keywords: Hydropower, open canal flow, dc motor, pulley, waterwheel

I. INTRODUCTION

In today's world electricity has become one of the major necessities and its shorting seriously influences the economic development of any country. Due to the rapid and continuous growth in population, urbanization and industrialization in India during the past few decades, the imbalance between the production and demand of electric power has led to a major energy crisis in India. As a result of this energy crisis, India is currently one of the few countries where load shedding is carried out to overcome the gap between production and consumption of electric power.

Irrigation canals located in the rural farming area have a potential to be utilized as a power plant. The flow of water in the irrigation channels has a more stable debit flow compared to the river stream. Discharge water in the irrigation flow relatively unaffected by changes of season or weather. These conditions are very suitable for the utilization of electricity generation that demands a continuous high water supply. As small scale, exploiting the energy of water flow irrigation canals can be an alternative option to build the installation of Micro Hydro Power Plant (MHPP). Hydroelectricity is a form of hydroelectric power changes with altitude and a particular discharge into electricity, using water turbine and generator.

The flowing water between the two floats rotates the water wheel which drives the AC variable frequency generator through gear, the generated AC power is used directly to store the battery bank, but this generator can also be used directly to the load. This floating generator can be anchored in any canal, flowing river or flowing stream. The generated power can be connected to load, if your load is continues like water pump for irrigation then this will keep on running for all the time but if your load is lighting load then you have to connect it to power controller for charging battery so that the generation of the day can be used to run more lighting load in night time, the direct lighting load without battery is not advisable because it will reduce your load to 1/3rd. The generation and harnessing of the power depends on the size of generator and flow rate of water. The system needs very low maintenance for a long period of time, because of low rpm generator and the type of quality materials used to fabricate this system, the generator used in the system is water proof with no carbon brush and no slip rings so the life of thegenerator system is very long with very low maintenance.

II. LITERATURE SURVEY

R. Sureshet at. [1], In GSM based Automated Irrigation Control using Rain gun irrigation System is automated microcontroller based rain gun irrigation system. Irrigation is done only when it becomes necessary to water the fields thus saving large quantity of water. Android based mobile device is used. Applications are developed on android platform using tools from android SDK in java programming language. The GPRS feature of mobile phone is used for proving solution to irrigation control problem. Sufficient amount of water can be given to the fields. The system sends messages using GSM. The android application is designed to overcome

irrigation problems such as under irrigation and over irrigation which causes leaching and other losses in soil quality.

Basava Sidramappa Dhanneetat. [2], In Modern Solar Powered Irrigation System by Using ARM. The design methodology of automated irrigation system in this paper includes the components, solar panel, arm processor, sensors, dc motors, relay, and battery. The main stress is laid on generating power supply by harnessing solar energy and reducing power consumption for irrigation purpose. The dc current is generated by using solar panel. This dc power is stored in a battery so as to operate the pump even during the night time.

S. Harishankaret at. [3], In Solar Powered Smart Irrigation System. The solar energy from solar panels is utilized to pump water automatically from bore well directly into a ground level storage tank. Apart from the conventional techniques, the system makes efficient use of renewable energy.

G. Muller et at. [4], Development of a floating tidal energy system suitable for use in shallow water. Gives the idea about the design of waterwheels which is useful in the electricity generation in shallow water. It may be possible that properly designing the waterwheel, the electricity generation is possible even in shallow as well as stream line water.

Lago LI et al. [5], Advance and trends in hydrokinetic turbine system. Transforming the kinetic energy of the hydro power is one of the alternative energy technologies; hence, there are concepts of using the energy of the hydro power such as canals, rivers, ocean and the flow of irrigation canals. By having suitable water supply management and technology, generating energy is possible from these alternative resources which are high potential energy resources.

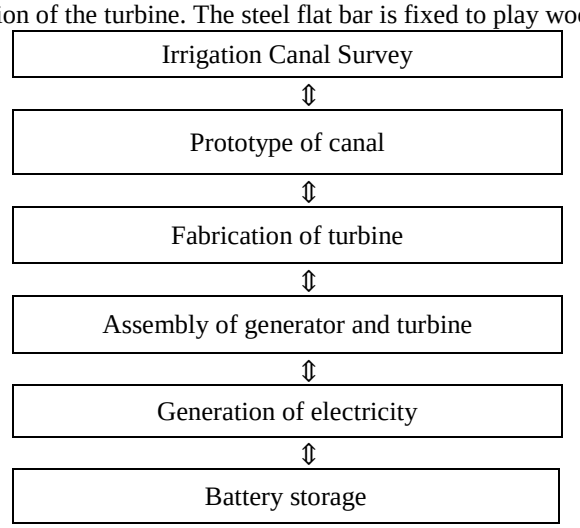
III. OBJETIVES

The main objective of this proposed work are as follows:

- To prove that the design of the simple horizontal axis waterwheel can generate power in form of electricity using irrigation canal water.
- To analyze the power output that can be generated from the rotating Turbine.
- The electricity generation using irrigation canal water is a pollution free concept, it has very low impact on the environment and it is efficient in actual as there is no wastage of any kind of fuel and energy.
- This project can provide constant year round electricity to small villages and agricultural use as there is plenty of irrigation canal water.

IV. METHODOLOGY

- At first step do the Basic canal survey
- A frame is made with given dimensions using 160 mm PVC (polyvinyl chloride) pipe is cut to a basic canal structure and fitted on to play wood.
- At second the shaft is required to support the rotating turbine. The turbine is made of plastic for lighter weight and smooth movement.
- The assembly of shaft and rotating turbine are mounted on to the steel flat bar that contains ball bearing for smoother rotation of the turbine. The steel flat bar is fixed to play wood using wood screw.



- A Nylon round belt pulley is attached to shaft on the other side and the bobbin is connected to DC motor and there are connected by smooth belt.
- Then LED light is connected to DC motor to the current is produced and Battery is connected to store the electricity.
- The water flows through the canal and turbine start to rotate and electricity is produced in the generator and stored in battery.

V. WORKING PRINCIPLE

A waterwheel is a simple turbine a device with buckets, paddles or blades that is rotated by moving water, converting the kinetic energy of water into mechanical movement.A water wheel is a machine for converting the energy of free-flowing or falling water into useful forms of power. It consists of a large wooden or metal wheel, with a number of blades or buckets forming the driving surface. The two main functions of water wheels were historically water-lifting for irrigation purposes and as a power source. In terms of power source, water wheels can be turned either by human or animal force or by the water current itself. Water wheels come in two basic designs, either equipped with a vertical or a horizontal axle. Waterwheels are most proposed or implemented devices for the extraction of energy from a flowing stream are Kaplan or Cross flow turbines. But they require high unit capital cost/KW that requires large scale applications to make them economical. Hence, it is useful to explore alternative concepts which may be more cost effective and more practical in remote and hostile locations.

Hydro-turbines or water wheels convert water pressure into mechanical shaft power, which can be used to elevate water or to drive an electricity generator. The power obtainable is proportional to the product of pressure head and volume of flow rate. The flow of water from the channel/injector enters to blade with high velocity, then continuously rotates the wheel and elevates the water simultaneously. The Fig.1 shows the experiment set and Fig .2 shows the Schematic diagram water turbine in Irrigation canal Structure.

VI. DESIGN AND CALCULATIONS

The machine was designed as per the procedure. The power was calculated through the design procedure.

- Total Area of Blade
  A_{bd1}= L × B
  L- Length of Blade = 11.7cm
  B – Breadth of Blade = 1.5cm
  A_{bd1}=(11.7 × 1.5)cm^2
  A_{bd1}= 0.001765m^2
- Area of Blade of dipped in water
  A_{bd2}= (05 × L) × B
  = 0.5 × 11.7 × 1.5
  = 8.75cm^2
- Mass of Flywheel
  $M = \pi \times (R-r)^2 \times b \times \rho$
  R- Outer radius of wheel = 0.095m
  r- Inner radius of wheel = 0.025m
  b- Breadth of the wheel = 0.015m
  $= \pi \times (0.098-0.025)^2 \times 0.015 \times 7800$
  = 1.95 kg
- Radius of gyration (K)
  K=(R-r)/1.4142
  = (0.098-0.025)/1.4142
  = 0.051m
- Moment of inertia (I)
  $I = m \times k^2$
  = 1.95 × 0.051
  = 0.099 kg-m^2
- Total Area (A_t) = A_{bd1} + A_{bd2}
  = 0.001765 + 0.000875
  = 2.64 × $10^{-3}m^2$
- Velocity (V) = 0.5 (by Float method)

- Discharge Q = A_t + V
  = $2.64\times10^{-3} \times 0.5$
  = $0.0132 m^3/sec$
- Assume tip speed ratio(λ) = 0.35 (From Fig. 3)
- Input power (P_i)
  $P_i = 0.5 \times C_p \times \rho \times A_v \times V^3$
  C_p-power coefficient = 0.8
  ρ - Density of water = $1000 kg/m^3$
  A_r – area of rotor = $(\pi/4) \times Dr^2$
  V – Velocity = 0.5
  $= 0.5 \times 0.8 \times 1000 \times (\pi/4) \times (11.7\text{-}1.5)^2 \times 0.5^3 \times 10^{-2}$
  $= 0.4085 \times 10^{-2}$ W
- Output power (P_o)
  $P_o = I \times V$
  $= 1 \times 12$
  = 12 W
- Efficiency(η)
  η = ((Power output) /(power input)) × 100
  $\eta = (Po/P_i) \times 100$
  $= (12/0.4085 \times 10^{-2}) \times 100$
  =29.37%

VII. FIGURES

Fig: 1 Experiment setup

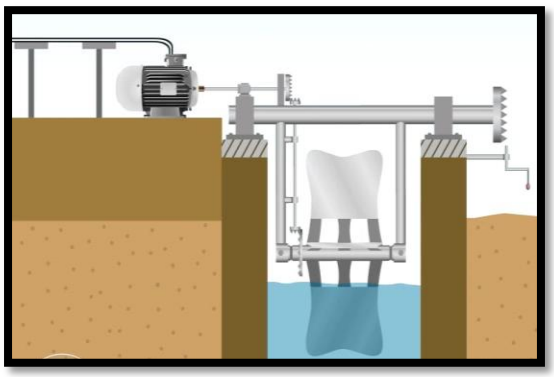


Fig: 2 Schematic diagram of Project

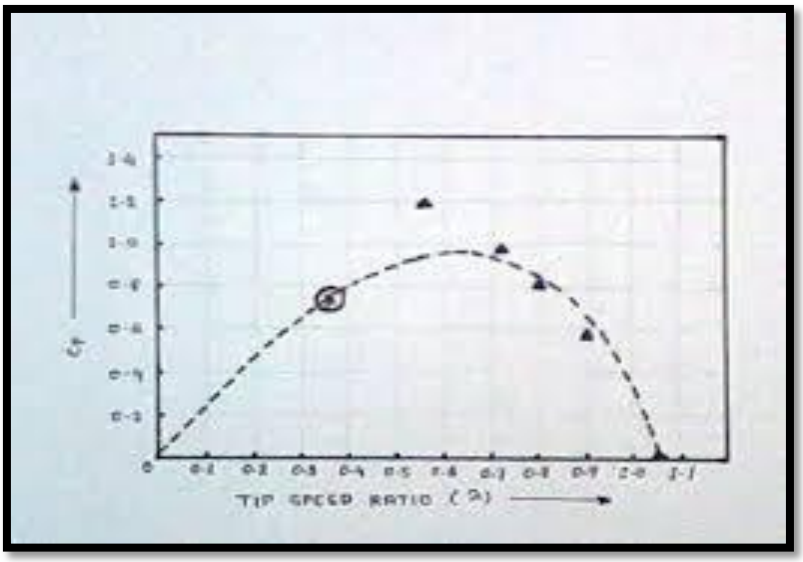


Fig: 3 Power coefficient vs Tip speed Ratio

CONCLUSIONS

The present design can be used in the areas where there is an abundance of free water. The sizes of the turbines can be different according to the power requirement of the users. According to our survey, we observed that there is a natural head of canal water. The turbine converts the kinetic energy of the flowing water into the rotational energy of the turbine and the generator. We have designed the improved hydro-dynamic fin structure which is capable to produce the required energy by utilizing maximum force and the velocity of the water. The available energy, therefore, depends on the quantity of the water flowing through the turbine and the square of the velocity of water.

The turbine, a renewable and sustainable energy system with effective technologies, low cost of operation and maintenance is very suitable in rural area with a water landscape environment. The traditional water wheel and water mill, which were constructed with a simple design with very basic technology, have a big economic impact on the rural economy.This study has discussed the utilization of small and diffuse hydropower potentials using irrigation canals. Such hydropower generation differs from other types in that we must carefully balance two competing objectives of the canal.

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