



PICO-HYDRO ELECTRIC POWER GENERATION FROM RESIDENTIAL WATER TANK

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ABSTRACT

Pico hydro electric power is both reliable and efficient form of clean source of renewable energy. This paper describes the design and development of pico-hydro generation system using consuming water from water tank of residential buildings. Water flow in the domestic pipes has kinetic energy that has the potential to generate electricity for energy storage. An introduction of three new mechanical arrangements namely the air bladder for water pressure maintenance, U-tube piping and broad nozzle pipe end are included for better working and energy generation. It produces electricity with no fuel cost and low maintenance. We could install a mechanical arrangement to generate electricity from the potential energy possessed by water storage tank from a water head of even 3m and above very easily. Hence, this paper is conducted to develop a small scale hydro generation system using consuming water from water tank as an alternative electrical energy source for residential use.

Key words: Pico-hydro electricity, Residential energy generation, U-Tube piping, Broad nozzle pipe end, Air bladder arrangement.

INTRODUCTION

Pico hydro is the hydro electricity generation methods with the maximum electric output of five kilowatts. The recent improvement and innovations in pico hydro technology have made it an easily available economic source of power even at remote places around the globe. This is a very versatile power source that could be used to generate AC electricity. Light bulb, radio, television and other similar electronic devices can be easily operated by using the pico hydro power.

The need of pico hydro electricity around the world is that it allows electricity generation simply and at no fuel cost. The growing high demand in electrical energy is

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forcing man to search for different available energy resources. The equipments used in pico hydro electricity generations specialised with its small and compact design, so that it could be installed in a small area very easily. The main benefit of pico hydro electric power generation is that it has a lower cost per kilowatt compared to that of solar or wind power. So pico hydro system is undoughtfully recommended in places with regular water flow.

Pico-hydro electricity

The pico hydro system makes use of the energy of water, which is stored in the water reservoir. The water, which is stored in a water tank of residential buildings with at least 3m head can be used for generation of pico electricity generation.

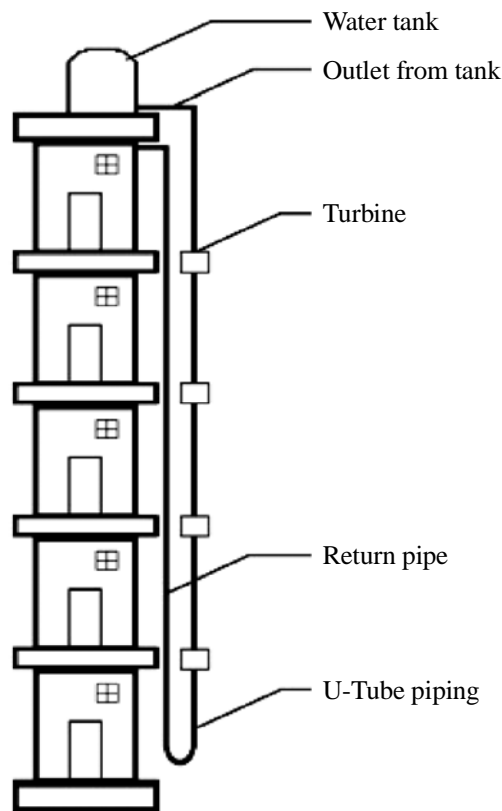


Fig. 1: Residential pico-hydro electricity

In multi stored buildings we place multiple turbines at a distance as per the availability of flow and usage of water. The water flows out of the tank through the pipes in which the end pipe is convergent to a nozzle, which allows high pressure jet. The pipe is made into to an oval nozzle with very narrow mouth, which pushes out the water as a line to

a large area for increased efficiency in electricity production. The hydraulic power is transmitted to a turbine runner by which a mechanical power is been generated.

The blades in the turbine runner are blades, which rotate when struck by strong water jet. The turbine is connected to the generator in order to convert the mechanical energy into electrical energy. In this way we can generate electricity from pipes even with low flow rate. An electricity controller is connected to a generator to match the electrical power that is produced. Energy needs of man forces him to use every form, which could be obtained.

Time of generation

In the residential building like flat the maximum consumption of water will be high during the morning time from 05.00 am up to 10.00 am. In this time duration almost all the people will be using one or more sources of water for cooking bathing or laundry needs. At this period of time we obtain the maximum flow rate since continuous consumption of water is occurring. The water tank should be filled up every day before the starting of consumption time both at head and water pressure will be maintained.

Volume of water tank

Initially we should consider a residential building like flats, villas where large number of people are thickly populated at a small area. The volume of water tank, which is installed in the residential building in the first place will have high capacity. As the volume increases then the maximum flow rate is obtained.

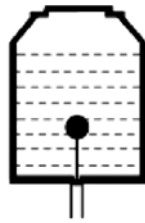
U-Tube piping

U-tube piping is the centralization of all water that is consumed even from the top floor and till the bottom floor. A new piping arrangement, which allows the more effective utilization of hydro power by eliminating the bends and other factors of energy losses. In this mechanical arrangement the pipe is installed in such a way that a long pipe goes vertically down till the ground and takes a U bent and comes vertically up to the tank level and continues by branching to the distribution pipe connections.

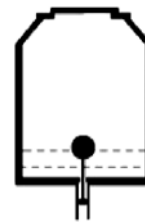
The piping gets its name because of the resemblance in shape to the U-Tube Manometer. This mechanical arrangement makes the available hydro power to get utilized all along the pipe line. We could install a turbine at 3m distance since this much water head is enough for the generation of electricity. This U tube piping enable the increased flow of water as the water consumed by the top floor till the bottom floor is been centralized.

Air bladder arrangement

When the water level is low in water tank, there across a chance of low water pressure, which may interrupt the distribution of water in the building. So at a height of minimum head for water pressure an air bladder arrangement is been made. And air bladder arrangement is been installed for controlling the level of consumption of water to the u-tube piping at low water head. Whenever the water is filled in the tank the air bladder floats up and causes the control valve to close. This is directly connected to a pipe for distribution in the residential building. When the water level lower than required level the air bladder covers down the and the valve opens allowing the water to flow directly into the distributions pipe without passing through the u-tube piping this check the maintains of water pressure allowing uninterrupted use of complete water.



Water in tank is full the air bladder goes using the direct opening to delivery pipe



When water in the tank does not have enough flow pressure the air bladder moves down and allows water to flow directly to delivery pipe

Fig. 2: Air bladder arrangement

Broad nozzle pipe end

The normal flow rate in pipe could be increased by using a nozzle. A new design is adopted for nozzle the nozzle to enable effective generation of power. The pipe is made changed to an oval nozzle with very narrow mouth, which pushes out the water as a line to a large area.

The nozzle is been designed especially for the cross flow turbine, so a linear opening for the mouth is been advised for the nozzle. After passing through the turbine area the pipe again converges back to the normal position allowing uninterrupted water flow. With a distance that could regain the head and flow rate for working of another turbine.

Cross flow turbine

A cross flow turbine is adopted to generate electricity in residential area due to its simple structure and high possibility of applying to small hydro power. The major benefit of

a cross flow turbine is the simplicity of design and construction. A cross flow turbine is based on concepts that are adopted from both the impulse and reaction turbine design but in general it shows impulse behaviour

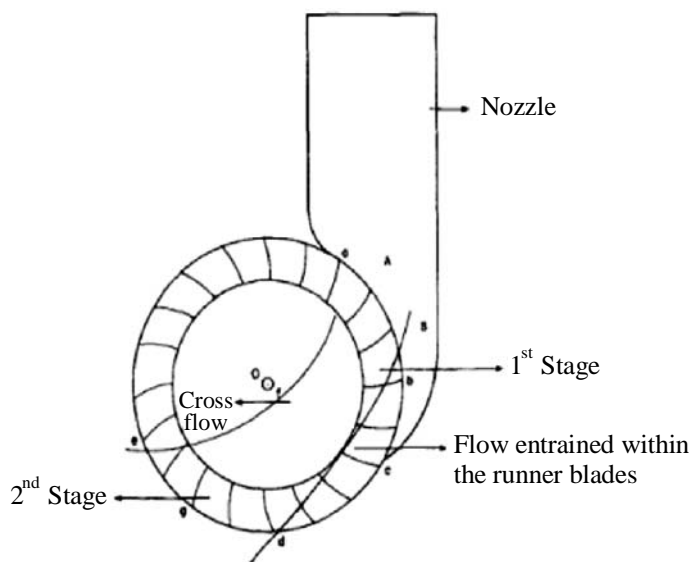


Fig. 3: Working of cross flow turbine

The simplicity in the design makes reduction of cost for manufacture and that factor of the cross flow turbine makes it best suitable for small scale power development.

DC Generator

A permanent magnet DC generator is preferred for generating electricity out of the mechanical power produced in a pico-hydro system. DC generator could provide high currents at even minimum voltage required for charging of the battery and operation of direct current loads. They are much cheaper and are small in size too. In this type of generator the efficiency is considered to be more since no power is wasted to generate magnetic field.

Battery charger

Batteries are used for storing of electrical energy and reused when necessary. The generator output is made connected to the charging circuits for energy storage. When charged a maximum load current is limited to 1.5 A, Ni-Cad battery is preferred for the pico-hydro system. Lead acid battery could be also used if necessary.

CONCLUSION

A pico-hydro generation system is to be designed as an alternative energy resource by consuming water from the water tank of residential buildings. This could be a reliable and eco-friendly form of energy, which can be generated to develop small scale hydro generation. This is very versatile power source that could be used to generate AC electricity even at remote places along around the globe.

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