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GENERATING HYDROELECTRIC POWER UTILIZING WATER PIPELINES

DR. R. A. BURANGE*1, AYUSH MISHRA*2, DHANASHRI KATRE*3, SAKSHI SHINDE*4

*1Professor, Department of Electronics and Telecommunication Engineering, KDK College Of Engineering, Nagpur, Maharashtra, India.

*2,3,4Student, Department of Electronics and Telecommunication Engineering, KDK College Of Engineering Nagpur, Maharashtra, India.

Abstract: Pico hydroelectricity is a good and reliable type of clean energy. In this project, we talk about making a pico-hydro system that takes water from houses' water tanks. The energy from the water flowing in pipes at home can make electricity for storing energy. To make it work better and produce more energy, we have three new mechanical setups: an air bladder to keep water pressure, U-tube piping, and a big nozzle at the end of the pipe. This system doesn't need fuel and doesn't need much upkeep to make power. We want to make a machine that uses the energy stored in water tanks to make power. So, the goal of this project is to create a small hydro system that uses water from a tank to make electricity for homes.

Keywords: Renewable energy, Hydroelectricity, turbine, diaphragm pump, portable etc.

I. INTRODUCTION

Hydro-electricity is a way of making power by using water. It works when water flows down from a high place and moves through pipes. This creates pressure and gives us strong liquid energy. People have been using water energy for a long time, even before they could make electricity. Back then, they used it to run machines, pump water, and grind grains. This has been happening for hundreds of years. Unlike wind and sun, we can rely on water every single day of the year, without any breaks. This helped early settlers a lot, as they could use water to power things like pumps and mills. Nowadays, we can use water to make clean energy that doesn't hurt the environment and doesn't cost too much. In this method, water from houses is kept in a tank and then moves down through a pipe. This movement creates electricity, but it doesn't make water bills go up. The main aim of this system is to store power for later use, like during a blackout when the power goes out. Even though it doesn't make a lot of electricity compared to other systems, like Pico micro hydro, it's still good. It only makes about 8 watts of electricity, but it's cheap, easy to use, and doesn't hurt the environment. Plus, you can put it anywhere you want. So, even though it's not super powerful, it's still a great way to make clean energy.

II. PROBLEM IDENTIFICATION

Energy is super important in our world. It helps with education, health, transportation, and making sure our communities work well. It's also really important for helping our economies grow and creating jobs. But in the last ten years, we've had some big problems with energy. We've had things like the oil crisis, climate change getting worse, and not having enough electricity when we need it. To fix these problems, we need smart solutions. One idea is to make electricity close to where we use it, using clean energy sources like wind, sun, tides, and moving water.

One of the best clean energy sources is hydroelectricity, which comes from moving water. To make power, the water needs to be moving. When water falls because of gravity, its energy changes from stored energy (called potential energy) to moving energy (called kinetic energy). Machines called turbines catch this moving water energy and turn it into mechanical energy by spinning blades or vanes. Then, a generator

changes this mechanical energy into electricity that we can use. People have been using water power for a long time. They used it to do things like grind grains, saw wood, and pump water for irrigation. The first water wheels were slow and simple, but over time, they got better and became hydroelectric turbines. In the 1880s, people started making big hydroelectric power systems. Nowadays, about 16% of the world's electricity comes from big hydroelectric dams.

But these dams can cause problems for the environment. They need a lot of land and can affect the flow of water. So, while hydroelectricity is great for making clean energy, we need to be careful about how we build and use it to protect our environment.

III. EXPERIMENTAL WORKING

Water tanks are placed up high to mimic buildings where people live. We need to think about buildings like apartments and villas, where many people live close together. The water tank in these buildings is big to hold lots of water. When the tank is full, we get the most water flow.

In the morning, from five to ten, apartments use the most water. Everyone is cooking, bathing, or washing. Since water keeps getting used, we have the highest water flow at this time. Every day before this, we fill the tank to keep the water pressure steady.

Here's how the whole system works:

- Three hydro turbine generators are put in the pipe. They work when water flows from the pipe at a certain height. All the water falls on a big hydro turbine generator, making it turn and create energy.
- The energy is sent through a DC to DC boost converter to increase the voltage. Then, it goes through a one-way current controller before being stored in a battery. A control board with an LCD display helps manage this.
- Another board changes the voltage from DC to AC. Finally, we connect an AC load at the end.

This makes the pipeline work using a prototype hydro power generation model.

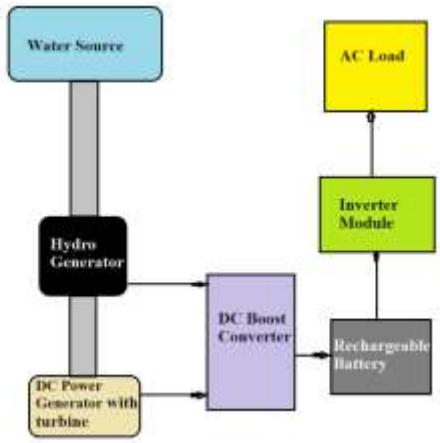

Fig.1. Block Diagram

IV. COMPONENTS SPECIFICATION

A. DC Generator

A strong magnet. The mechanical energy made by a small hydro system is best for a DC generator. A DC generator can give big currents even at low voltages for batteries and running direct current things. They're cheaper and smaller. Making the magnetic field doesn't waste power, so this generator is more effective.

Fig.2. DC Generator

B. Hydro Turbine Module

A water turbine is a spinning machine that uses the energy from moving water to do work. Water's energy from both its position and movement is used. When water flows onto the turbine's blades, it pushes them, causing the turbine to rotate. This spinning motion transfers the water's power to the turbine, making it work.

Fig.3. Hydro Turbine Module

C. 12V Battery

To save the electricity made by solar and wind power, we use batteries. The size of the solar or wind plant can affect how much the battery can hold. It's good if the battery doesn't lose much charge and needs little upkeep. The best type is one that doesn't discharge on its own. We can connect many batteries together, either in a line or side by side, to make them store more or less energy, based on how much power the hybrid systems produce.

Fig.4. 12V Battery

D. DC to DC Boost Converter

A boost converter, also called a step-up converter, is a device that changes DC electricity from a lower voltage to a higher voltage. It does this while lowering the amount of electricity flowing through. This kind of power supply usually has at least two electronic parts, like a diode and a transistor, and a storage part like a capacitor or an inductor. Filters made of capacitors are often used to smooth out changes in voltage at both the input and output of the converter, making the electricity more stable.

Fig.5. DC to DC Boost Converter

E. Light-Emitting Diode (Led)

The longer lead in an LED, which is marked as (+), is called the anode. The shorter lead, marked as (&minus), is called the cathode. In the symbol for an LED, the anode is shown on the left side, while the cathode is shown on the right side. LEDs are small parts used in electronics to create light signals.

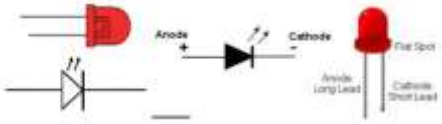

Fig.6. Light-Emitting Diode (Led)

F. Micro hydropower Generator (12V 10W)

A small hydropower system requires a turbine, pump, or waterwheel to change the energy from moving water into spinning energy. This spinning energy is then turned into electricity.

Fig.7. *Micro hydropower Generator (12V 10W)*

v. ADVANTAGES

1) It produces clean energy without harming the environment.
2) Unlike solar and wind power, it doesn't depend on the weather.
3) It doesn't affect the quality of drinking water.
4) It's cheaper than solar and wind energy.
5) It can be used in pipelines for wastewater, agriculture, and industry.
6) Water flow continuously generates electricity.
7) Installation is fast.
8) It recovers energy from various processes.

VI. CALCULATION

Power Generation in a micro hydro system, the head and the flow of the water in a river or stream define its power potential. One can calculate the potential power as follows:

$$P = Flow\ rate(Q) \times Head(H) \times Gravity(g) \quad (2.1)$$

$Where$

$P = Power\ (W)$

$H = Head\ (m)$

$Q = Water\ flow\ (m3/sec)$

$g = gravity\ constant\ (9.81\ Newton)$

When the water pours out of the pipeline and falls over the head, this potential energy will be converted into kinetic energy. This kinetic energy is a form of pressure that causes the hydraulic turbine's shaft to rotate. The synchronous generator will then be powered by the mechanical energy from the turbine to generate alternating current (AC) electricity. The distribution of the electricity to homes will follow. For the AC power source to reliably power any electrical equipment using it, it must be kept at a steady 50 or 60 cycles per second. The speed of the turbine, which needs to be extremely precisely managed, determines this frequency. The ideal geographic regions for using micro-hydro power are those with steep rivers that flow all year round, such the hilly regions, the hill areas of countries with high year-round rainfall, or the great mountain ranges and their foothills.

VII. EXPERIMENTAL RESULTS

In this part, Table 3 summaries the empirical findings for the suggested turbines, where the power varied depending on the model design employed. The following formula can be used to estimate the output power in a gravity-fed in-pipe hydropower plant. [8], [11]:

$$P = \eta \times \rho \times H \times Q \times g \quad (1)$$

Where

P = The output power [W]

η = Turbine efficiency

ρ = Water density $\left(1000 kg/m^3\right)$

H = Net head (m)

Q = Water flow rate $\left(m^3/s\right)$

g = Gravity acceleration constant $\left(9.8 m/s^2\right)$

The speed in rpm was measured using a tachometer, and the pressure was measured using a Differential Pressure (DP) transmitter. The speed in (rad/s) was calculated using the following Equation,

$$\omega = \frac{2\pi N}{60} \quad (3)$$

$where,$

$N = revolution\ per\ minute\ (rpm)$.

The flow metre with the Arduino was used to calculate the flow rate. Due to their poor performance, the spherical turbines with three and four blades have been removed from the study.

PROJECT IMAGE

Fig.8. Power Generation from Water Pipeline in Hydro Power Generator

VIII. FUTURE SCOPE

- Making electricity doesn't release carbon into the air.
- Electricity is made without coal or oil, so natural resources last longer.
- It will reduce how much electricity each unit uses, so more places can have power.
- It's safer than nuclear power and fossil fuels, which can have harmful chemicals that affect health.

IX. CONCLUSION

A small hydropower system will use water from water tanks in houses to create energy. This could become a reliable and eco-friendly way to produce electricity on a small scale. It's a flexible power source that can give electricity, even in faraway places. This system is designed to be simple and easy to use. It could be a great solution for areas that don't have access to traditional power sources. With this system, we can make electricity without harming the environment. It's a step toward using cleaner energy and reducing our impact on the planet. This technology could change how we think about power and help communities around the world.

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