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Design and implementation of micro hydro turbine for power generation and its application

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Abstract - *The main motive of this project is to generate dc power from low head water source .Water is an essential requirement for human being as like air, food etc. It is used for many purposes but it has one more advantage is, it is used for domestic power generation for other uses. Consumer wants to reduce the electricity bills so we use this type of power generation. Hydropower is renewable energy source that doesn't cause global warming because it does not releases dangerous greenhouse gases.*

Key Words: Micro hydro turbine, DC generator, Pelton turbine, Inverter.

1. INTRODUCTION

Hydro power is a renewable, non-polluting and environmentally source of energy. Moving water fall on turbine the turbine spins a generator and electricity is produced. It is like the oldest renewable energy technique known to the mankind for mechanical energy conversion as well as electricity generation. In this work, by using micro hydro turbine with dc generator generate electricity and it distributes to the domestic use. It consists of water storage tank, pipe, nozzle, turbine, dc generator, battery etc. Tank is placed on the multi storey building at height 11.25 meters. The various turbines are available out of which we use the pelton wheel turbine. Potential energy of water is converted into kinetic energy. The water from the pipe moves vanes of the turbine, then turbine rotates and it provides it's mechanical output to generator. This generator converts mechanical energy into electrical energy and produced electrical energy stored into battery.

2. THEORY

The storage of water in the overhead tank on multi storey building used for domestic purpose. This water possesses potential energy because of head created it can be converted into mechanical energy with the help of turbine. By using velocity or water force a turbine can be rotated and electrical energy is generated. In this project we are going to generate a DC power by using DC generator [2].

This method of generation of electrical energy has become very popular because it has low production and maintenance cost.

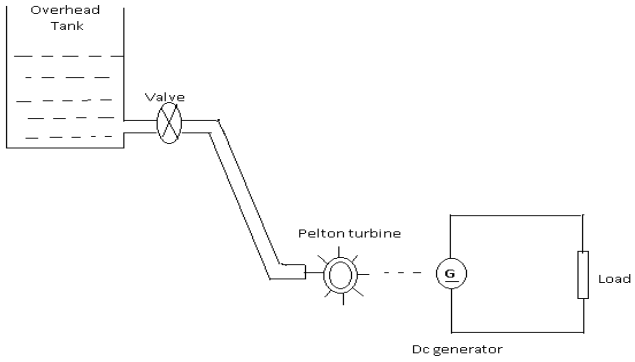

Fig -1: Micro Hydro Turbine System

2.1 Potential energy of water

Mass that has been raised above the Earth's surface has a potential energy relative to the same mass on the Earth's surface. Running elevated water over a turbine, some part of this potential energy can be converted into kinetic energy. This kinetic energy is then converted into an electrical energy. The amount of electrical energy that can be generated is equal to the potential energy of stored water[1]. This gravitational potential energy is equal to the product of mass, height, and gravitational constant (9.81 m/s^2).

3. COMPONENTS

3.1 Tank

The overhead tank is fixed storage structure situated at a height of 20-30 meter. The tank is cylindrical in shape and it is made up of plastic or concrete with capacity of 5000 litre. The approximate diameter of tank is 2 meter.

3.2 Pipe outlet

The outlet of the pipe is depends on the following factors:

1. The flow of water or discharge: The flow of water is simply the amount of water flowing in the water source.
2. Head: Head is the vertical distance from the water source to the generator.

3.3 Pelton turbine

It consists of rotor equipped with buckets along the whole periphery of turbine. The buckets are of elliptical shape as shown in figure. As stated earlier the total available head is first converted into kinetic energy and strong water jet through one or two jets is directed to impact on this buckets. The rotor starts turning due to the impact of jet on the buckets. The buckets are found into two halves with a splitting at the Centre in a such way that the jet after hitting in the Centre, deflects sideways and then falls into the tail race at velocity of 10% to 15% of initial velocity. But in order to utilize the water energy it is necessary that outlet velocity of the water should be minimum[3].
In order to increase the output power 1 to 4 jets may be spaced at equal distance along the circumference of the wheel. Use of number of nozzles is not generally preferred because the water pipe supplying water to these jets has to be bend around which cause disturbance in water flow. At least one jet of water strikes the buckets at atmospheric pressure.
•Maximum jet diameter about 1/3 bucket width
•More jets increase flow and are used at low head.

Speed regulation of Pelton

The quantity of water discharge by the nozzle can be controlled by controlling the nozzles opening by means of needle placed in tip of nozzle. When the speed of pelton wheel increases the needle moves forwards thus the quantity of water impinging on the buckets is decreased and the action result into decreased speed. The reverse action takes place when the speed decreases. The movement of the needle is control by the governor.

Further as the pelton wheel is coupled to the alternator, it is necessary that the speed should remain constant. In addition to the needle for control of speed, deflectors are used. The deflectors simply deflect the water jet totally or partly clear of the wheel.

Fig -2: Pelton Turbine

3.4 DC generator

The factors where used in selection of DC generator for the project: Number of rotation, Cost and available power.

3.5 Inverter

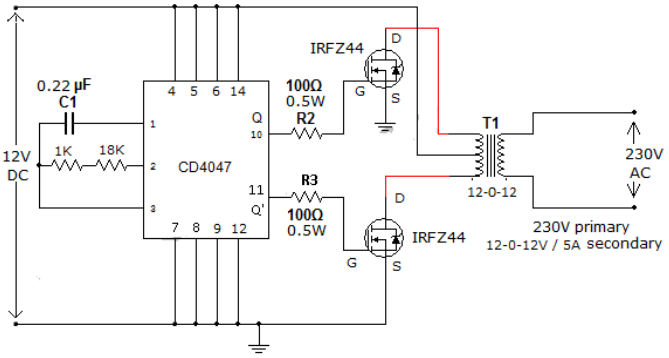

Fig -3: Circuit diagram of DC to AC Inverter

The inverter circuit is built around IC CD4047 which is work as astable multivibrator. The operating frequency of astable multivibrator is set to 50Hz.The power MOSFETs IRFZ44 are directly driven by the Q and Q' output of CD4047.The power MOSFETs are connected in Push Pull configuration (Power amplifier). The MOSFETs will switch according to the pulse from CD4047 astable multivibrator.

Thus an AC voltage is transferred to the primary of transformer; it is stepped up to 230V. The transformer used here is an ordinary step down transformer which is connected in inverted manner. That is, the primary of a 230V to 12V-0-12V step down transformer can be treated as secondary for this inverter. Use suitable heat sinks for MOSFETs.

4. DESIGN CONFIGURATION

1. Tank capacity = 5000 liter
2. Height of water tank = 1.56 meter
3. Height of college building = 11.25 meter
4. Total Head = 13 meter
5. Diameter of tank = 2 meter
6. Length of penstock = 42 meter
7. Diameter of penstock = 0.03 meter

4.1 Calculation

1. Net head (H_n):-

$$H_n = H_g - H_{tl}$$

= 12.22 m

2. Velocity of jet: = $C_v\sqrt{2\times g\times H_n}$

= 15.17 m/s

3. Discharge through nozzle (Q):-

Q = Area of jet × Velocity of jet

= 2.6806×10^{-3} m^3 / s

4. Diameter of jet (D_j) = 1.5 cm

5. Diameter of runner (D_r) = 16.5 cm

6. Jet ratio (m)= D_r/D_j= 16.5/1.5 = 11

7. No. Of buckets on wheel (Z) = 15+ ($D_r/2D_j$)

= 18 nos

8. Depth of the bucket (B_d) = 1.2 ×D_j

= 1.8 cm

9. Length of the bucket (B_l) = 3.4 × D_j

= 5.1 cm

10. Power input to turbine (P_{ti}) = ρ × g ×$(Cn)^2$ × H_n ×Q

= 308.55 watts

5. RESULT

Testing setup is implemented on college building using pipeline which is going to the plant irrigation. The test results are as shown in the Table:

	Parameters					
	Head (m)	Discharge (m^3/s)	Water Power Available (kW)	Current (mA)	Voltage (Volt)	Output Power (kW)
1	13	0.00268	308.5	.250	19	0.047
2	12	0.0025	287.8	.220	18	0.039
3	12	0.0022	253.2	.200	18	0.036

6. CONCLUSIONS

From this project we conclude that by using this technology electricity can be produced and is stored in battery which can be used whenever and wherever required. Hydro-electric power has always been an important part of the world's electricity supply, providing reliable, cost effective electricity, and will continue to do so in the future.

8. FUTURE WORK

Since, renewable energy is the future of the power generation as electricity to all by Shri Narendra Modi. A small micro hydro turbine and dc generator set should be developed so that it can be fixed in water pipe line like this sets fixed on each floor of multi storey buildings.

LIST OF ABBRIVATION

B_d = Depth of Bucket
B_l = Length of Bucket
C_n = Velocity Constant
D_j = Diameter of Jet
D_r = Diameter of Runner
g = Gravity Constant
H_g = Total Head
H_n = Net Head
H_{tl} = Total Loss In Head
m = Jet Ratio
P_{ti} = Power Input To Turbine
Q = Discharge Through Jet
V_j = Velocity of Jet
Z = No. of Buckets

REFERENCES

[1] Shaleen Martin, K. K. Shrivastava, "Feasibility of Rainwater Harvesting in Highrise Building for Power Generation", IJETT-Volume4Issue4- 2013.

[2] Shaleen Martin, Abhay Kumar Sharma, "Analysis on Rainwater Harvesting and itsUtilization for Pico Hydro Power Generation", IJARCET Volume 3 Issue 6, June 2014.

[3] Kunal Roy, S.Sreevidya, S.Sai Siri, "Hydro Hybrid Power Plant and Control System Feedback",IJESI-Volume 2 Issue 11, November 2013

[4] K. Tejaswini Gharge, Supriyashintre, "Design development of micro hydro turbinre and performance evaluation of energy generation for domestic application ". IJRSET Volume 2,Issue 2.

[5] Bilal Abdullah Nasir, "Design of micro- hydro- electric power sataion",IJEAT, ISSN: 2249- 8958,Volume 2, Issue 5,June 2013

[6] Lalitha.S, "Micro-Generation of Electricity From Tap Water",IJETAE-Volume 3, Issue 10, October 2013.

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