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Design and Fabrication of Domestic Hydro Turbine

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Abstract: **Day by day the demand of electricity increases, due to growing population & commercialization. The power consumption is more than generation by conventional method. Hence, hydroelectricity exist as one of the option to meet the growing demand for energy by nonconventional method. The performance of hydro turbine is strongly influence by the characteristic of water inertia. So in this paper we are attempting the way of micro generation of hydropower for domestic purpose.**

I. INTRODUCTION

In hydro power plant we use the gravitational force of water to run the pelton turbine which is coupled with electric generator to produce electricity. There are various types of turbines used for hydro power generation. Among them pelton turbine is use on medium to high head sites.

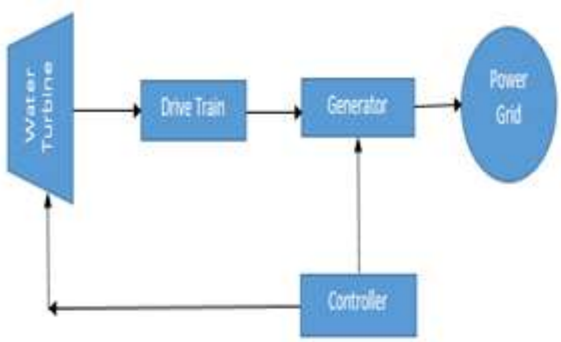


Fig:1 General layout of hydro power generation

II. BACKGROUND AND PURPOSE OF STUDY

Because of depleting fossil fuels, the potential of the world is to establish a system of non-conventional energy sources as economic to everyone at optimum rate. Many researcher found the application of these renewable resources in a determined way and given a thesis from their level of perception which are as follows:

Through the next several decades, renewable energy technologies, thanks to their continually improving performance and cost, and growing recognition of their Environmental, economic and social values, will grow increasingly competitive with Traditional energy technologies, so that by the middle of the 21st century, renewable Energy, in its various forms, should be supplying half of the world's energy needs.[1]

III. PRINCIPLE OF OPERATION

It works on the principle of converting the kinetic energy of water into mechanical energy which is obtained by rotational movement of impeller and is further converted into electrical energy.

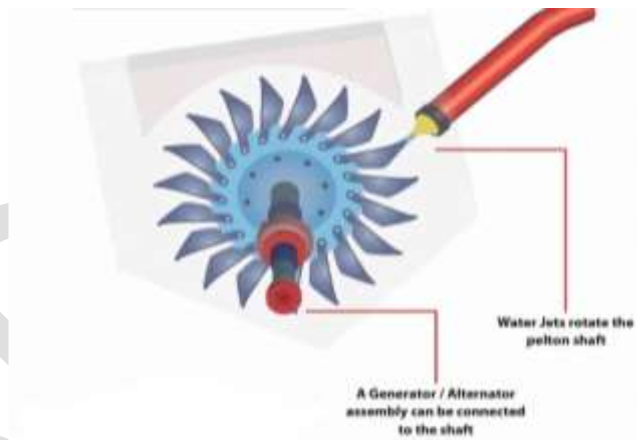


Fig:2 Principle of pelton turbine[2]

IV. BUCKET DESIGN

Most vital component of Pelton wheel is its bucket. Buckets are casted as single solid piece, in order to avoid fatigue failure. Which is fabricated from spoons of stainless steel having 6.7 cm diameter and length of 7.0 cm. Water jet is split into 2 equal components with help of a splitter. The special shape of bucket makes the jet turn almost 180 degree. This produces an impulsive force on bucket. Force so produced can easily be derived from Newton's 2nd law of motion. Blade outlet angle close to 180 degree is usually used in order to maximize impulsive force. A cut is provided at the tip of buckets. This makes sure that water jet will not get interfered by other incoming buckets.

Fig:3 Pelton wheel

V. NOZZLE

Generally, nozzle is used to control the flow rate of water. It converts the total head at the inlet of the nozzle into kinetic energy. Connected at the end of pipe to convert flow of water into jet pressure to strike on curve buckets.

Fig:4 Nozzle

VI. CALCULATION OF HYDRO POWER

Hydro power depends on:

Water flow rate (Q)

Velocity of jet (V)

Total Head (H)

Number of buckets (N)

The flow rate of water is calculated by calculating volume of tank and time require for filling the tank.

Flow rate (Q) = $\frac{volume}{Time\ (T)}$

Volume of tank = $A \times L$ = 29.25 × 0.1= 2.925m^3

Time calculated for 30 minutes

So, flow rate (Q) = $\frac{2.925}{30\times60}$

= 1.625×10^{-3} m^3/s

Numbers of buckets **:**

Total numbers of buckets depends on the jet ratio of water.

Diameter of turbine (D) = 0.4572m

Diameter of jet (d) = 0.0245

Jet ratio (m) = $\frac{D}{d}$

= $\frac{0.4572}{0.0245}$

= 18

Number of buckets = 15+0.5× m

= 15+0.5× 18

= 24 No.s

VII. POWER ESTIMATION

As we install the turbine set-up on the terrace tank. So the head is considering from bottom of building till above the tank

. Height of building = 50ft = 15.24m

Length of pipe from bottom of tank = 1.85m

So, Head (H) = 15.24 + 1.85 = 17.09m

There is some friction losses occurring in pipe. Therefore considering the friction head in total head.

Friction factor (f) = 0.01

Diameter of pipe = 2inch = 0.0508m

Friction head,

$$hf = \frac{4fLQ^2}{12.1 \times d^5}$$

$$= \frac{4 \times 0.01 \times 17.09 \times (1.625 \times 10^{-3})^2}{12.1 \times (0.0508)^5}$$

= 0.44m

Total Head = H + h_f

= 17.09 + 0.44

= 17.53m

Gravity (g) = 9.81 m/s^2

Power (P) = H× Q × g

= 17.53 × 1.625×10^{-3} × 9.81

(P) = 279.4 W

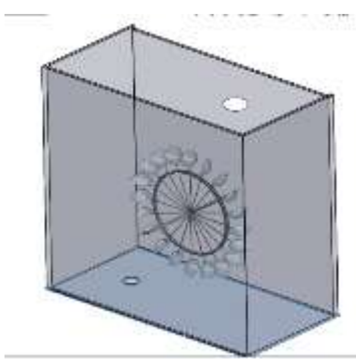
VIII. PROCEDURE

1) Bought the steel spoons of required diameter for bucket
2) Cut the spoon from end to make the splitter of same material so it is feasible for welding it.
3) Mark the curve on the cut part of spoon for making splitter and grind it smoothly so that it easily fit inside the spoon as shown in fig5(b).
4) Mark and cut the ‘U’ shape at the tip of spoon.
5) Weld the splitter in spoon and make sure that no gap remains in between them.
6) Mark the angles on the rim according to number of bucket as per the calculation.
7) Weld the buckets on the rim.

8) Finally, the whole assembly of turbine is enclosed in casing. For preventing the splashing of water and discharge the water to tailrace.

(a)

(b)



(c)

Fig: 5 Actual fabricated pelton turbine

IX. CONCLUSION

Hydro power is natural source of energy which available at free of cost and the best part about it is they are plentiful. Hydro domain pertain to more enthusiastic search for alternate source of energy including small scale hydro power. By this small domestic model we can produce power 280W which is directly proportional to flow rate, so that as the rate of flow increases subsequently power will increase.

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