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Harvesting Energy from Water Transportation Pipelines

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Abstract: As the demand of electricity is increasing globally we need easy eco friendly and smarter alternatives to compensate for the same. Today most of dams and rivers accommodate small turbine systems in order to generate electricity by using the force of water. It would be revolutionary if the transportation of water through pipelines could be used to generate electricity. In this paper we would like to present how a water turbine placed inside a water pipe can generate electricity by using water pressure to move the turbines.

KEYWORDS: Turbines, Generator , Microcontroller, Rectifier, VSI

I. INTRODUCTION-

Due to the growing need of cleaner living environment, renewable energy is becoming a necessity. The potential energy stored in water through pressure can be captured using inline turbines coupled with generators in water transport pipelines. The project includes installing inline turbine generator in the existing pipelines, according to the specification of the pipelines, without subsequent loss in the water pressure. We plan to capture some of this untapped energy of flowing water by converting the flowing potential of water into electricity. We tend to compensate the loss in water pressure by using a microcontroller, which will further automate the motor at source. This setup aims at using the force of the moving water in pipes to generate electricity that can be either stored or immediately used in nearby areas. It uses smart water management solutions that improve the economics of delivering water. This paper shows the technique used for the same. Following this technique the load from existing power plants would be reduced, and could be even used to cover remote rural areas.

II. DESIGN

The system block diagram is shown in Fig. 1 below. Water flows from the source, through a Pumping motor, a turbine, and then onto its original destination. The speed of the pumping motor for desired pressure will be controlled by a power electronic circuit.
Microcontroller is used in this project to take reading from generator whether the voltage is optimum or not and decide whether to increase or decrease the speed of pumping motor accordingly. Power electronic circuit and microcontroller is used as feedback circuit.

1. Pumping motor:

   Pumping motor used in the system is an induction motor which helps in the flowing of water with pressure from source so that the water pressure at turbine is adequate to turn the rotor of turbine and reach the destination without any loss in pressure. With this motor a feedback system is provided using micro controller which checks the output voltage from generator and thus increases or decrease the speed of induction motor so as to as to achieve desirable output voltage. Speed of the induction motor can be controlled using v/f method as it makes the system more convenient and increased efficiency can be obtained.

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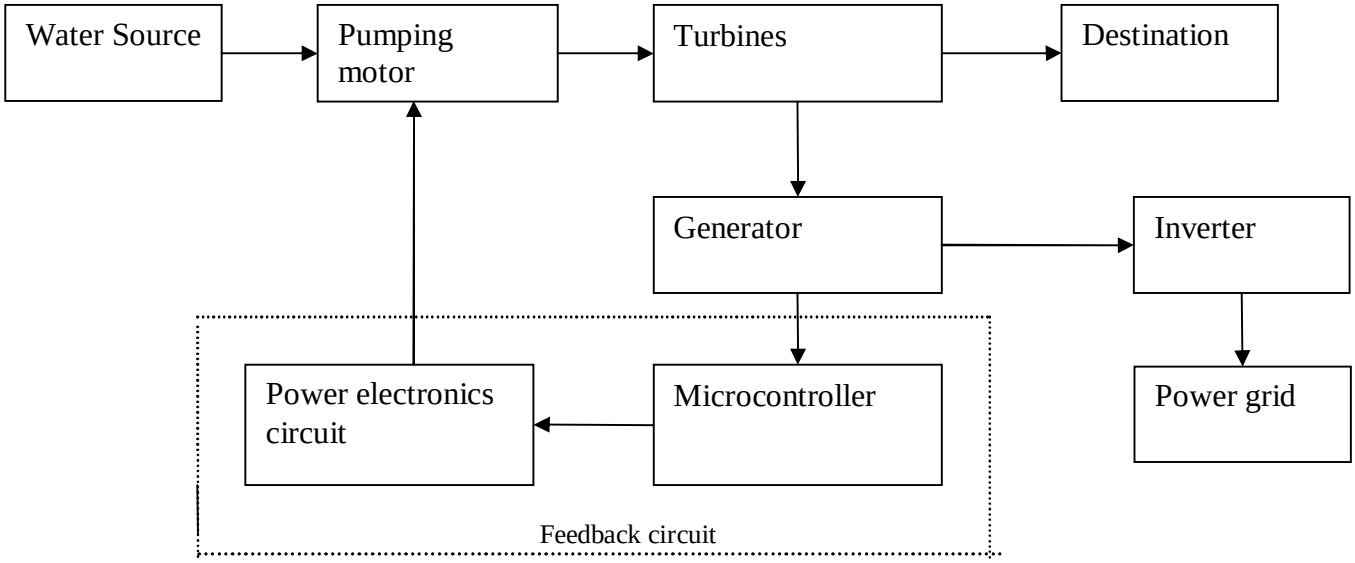

Fig 1

2. Turbine:

Water from the pipelines reaches the turbine. turbines are a part of the generating unit which convert the energy of rushing water into mechanical energy to drive a generator Turbines used in the system depends on the water system specifications for the town ,while choosing the turbine according to the specification, the Efficiency and cost of the turbine must be kept in mind. Turbine must rotate at an optimum speed so that optimum amount of voltage is achieved.

3. Generator:

Generator is generating unit in which mechanical energy of turbine is converted into electrical energy. In a standard brushed generator, there is unnecessary amount of heat produced due to brushes. These brushes constantly rides along the commutator making the generator less efficient and requires more maintenance. To overcome the problems of brushed generator we proposed to use brushless generator which is nowadays used in most modern hydro-electric power plants. By using a brushless generator, the coils remain stationary while the magnets are rotating. Therefore, the rotating part requires no electricity and thus, no brushes. Making it much more efficient in terms of friction, heat, maintenance, and overall efficiency

4. Micro controller:

Microcontroller is part of the feedback circuit which is used in in order to take feedback from the voltmeter and decide whether to increase or decrease the speed of the pumping motor. Hence, maintaining the water flow in the pipeline. Microcontroller of 8051 family is used in this project

5. Power electronic circuit:

As shown in figure 2 this circuit contains a rectifier which converts the pulsating dc to constant dc and further feeds it to VSI which is fed to the pumping motor as feedback.

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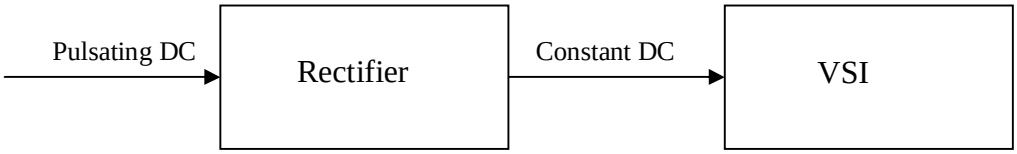

Fig 2

6. Inverter:

The generated electricity through turbines can be stored or can be used. To convert the electricity from DC to AC .We proposed in this paper to use a PWM inverter which converts the generated DC output to AC.

III. WORKING

Water is pumped through pumping motor in the pipelines. The pieces of pipelines are fitted with turbines. The flow of water will rotate the turbines producing mechanical energy, the turbine is coupled to a DC generator which will convert this mechanical energy to electrical energy. In order to produce optimum amount of voltage the turbine should be rotated at a specific speed. To govern this speed a feedback system has been proposed which controls the flow of water by changing the speed of the pumping motor at the source.

A microcontroller is used which will compare the generated voltage with the threshold voltage programmed in the microcontroller, triggering the SRC in the rectifier circuit (part of Power Electronic circuit) in order to provide feedback to the pumping motor to change the speed accordingly. If the electricity produced is less, then the speed of motor would be increased by decreasing the firing angle of the SCRs and vice versa. Hence this system would maintain a constant output of the generator.

The rectifier and inverter are coupled together in order to firstly convert the pulsating DC, from the DC generator, to smooth DC and then finally converting it to an AC output to be fed to the pumping motor as a feedback.

IV. APPLICATIONS

1. The rural areas that are present nearby the pipeline network can be supplied with free or low cost electricity.
2. It can be installed in existing pipelines networks hence setup cost is low.
3. The water used in producing electricity isn't wasted or consumed in the process.

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