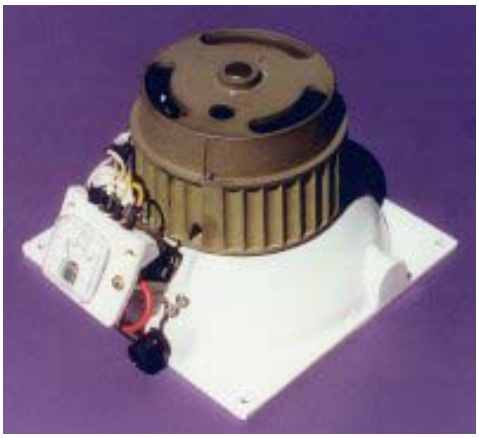
HARRIS HYDRO

How It Works:



The Harris system is an efficient, durable battery charging pelton turbine. It is especially well suited to produce usable power from springs and creeks that are too small to sustain the same level of useful power from a conventional A.C. generating system. Water is collected upstream from the hydro and piped downstream to where the turbine is located. As a rule the greater the head, (the difference in elevation between the collection point and the turbine is called the head) the better. Because D.C. power can be stored in batteries, these small systems operate 24 hours a day collecting energy, a little at a time, to be delivered "on demand" from the batteries as the need dictates.

A 4-nozzle P.M. (Permanent Magnet) generator-equipped turbine. (picture right) The multiple nozzle arrangement allows considerably more water to impact the runner, resulting in greater output at any head, and usable power at a much lower head. All turbines include an output-optimizing circuit allowing maximum efficiency at any flow rate. Multi-nozzle systems include PVC penstock and individual ball valves on each nozzle.

The pelton type runner is a lost wax cast of silicon bronze. The wheel is 70-90% efficient, depending upon nozzle size and head. The bucket shape allows high efficiency for nozzles and provides a flow range of over 100:1. The wheel has a hydraulic diameter of just over 4" and each wheel is individually balanced.

Adjustable Strength Permanent Magnet Rotor Advantages.

Historically small alternators have had either wound electromagnetic fields or fixed strength permanent magnet fields. Wound fields have a 3% to 5% loss in efficiency from electricity used to run the coil, as well as brush maintenance and coil failure problems.

Fixed PM (permanent magnet) fields are efficient at one flux density only and cannot be changed. In many applications (i.e. small hydroelectric generators) the load requirements change and the corresponding field flux density should change.

Previous attempts at variable strength PM rotors have been (a) iron shunting the magnets; (b) pancake-type generator with disk rotor that the air gap is varied to control field strength.

a) Iron shunting has been limited to low flux density because not enough iron surface is available to magnetic induction and multiple air gaps required.

b) Air gap variation has had very low efficiency at large air gaps because of flux leakage into unwanted conductors resulting in high eddy current losses.

Rotor with Stationary Control Circuit Advantages.

The stationary magnetic control circuit allows the flux density in the rotor to be adjusted while the alternator is operating. This allows peak power point tracking and more convenient operation.

The rotor design has the advantage of being very efficient at all flux densities because the flux path remains within the rotor at all reduced flux levels, not allowing eddy current losses in the stator or other conductors. Further, the iron pole piece can be easily shaped to optimize the wave form output of the alternator.

The simple rotor can be adjusted by rotating one ring of magnets with respect to the iron pole pieces and the other magnet ring i.e. a rotation of one pole piece will change flux density from full to null.

Another advantage of this rotor design is the rotor pole piece, which interacts with the stator, can be made of low eddy current materials and can be laminated, increasing alternator efficiency.