Pelton Wheel Hydraulic Turbine

Object:

The performance characteristics of a Pelton wheel hydraulic turbine are to be determined. Specifically, torque and power are to be presented as a function of turbine speed.

Equipment:

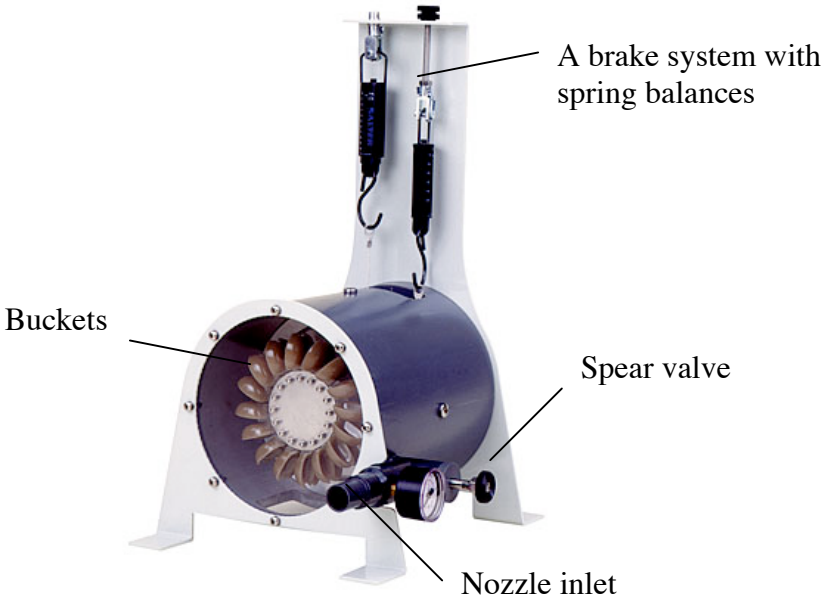

Figure 1 Pelton wheel

The Pelton wheel hydraulic turbine is driven by a jet of water issuing from a nozzle and striking the buckets on the wheel causing it to rotate and thus develops a power output. This creates a torque on the wheel. The flow rate of the water jet is controlled by a spear valve. After the flow leaves the turbine casing it empties into a hydraulic bench where its volume is measured along with the time using a digital timer. This will then give the volumetric flow rate through the turbine. The turbine wheel speed is measured by a digital tachometer. The torque on the turbine wheel is measured by a brake system with spring balances.

Procedure:

1) Close the spear valve on the turbine inlet and close the flow control valve on the hydraulic bench.
2) Turn on the pump in the hydraulic bench and fully open the valve on the bench.

3) Slowly open the spear valve allowing the jet to drive the Pelton wheel. Fully open the valve (about 4 and half turns from the closed position)
4) Increase the load on the wheel by adjusting the knob above the spring balance at the desired intervals. This will change the wheel speed.
5) At each interval record the speed by using the digital tachometer and both spring balance forces.
6) Repeat procedure for six different turbine speeds (about equally spaced from 200 to 700 rpm).
7) Repeat the procedure 3 – 6 by opening the spear valve 2 turns from the closed position.
8) When finished close the spear valve and then close the flow control valve on the hydraulic bench. Also release the tension on the spring balances.

Theory:

1) The equation to find the torque on the wheel from the water jet is

$$T = (F_1 - F_2)\, R \qquad (1)$$

where T = torque (N•m)
F_1 = load reading on 0-25N spring scale
F_2 = load reading on 0-15N spring scale
R = brake wheel radius (0.025m)

2) The equation to find the power produced by the turbine is

$$P = 2\pi NT/60 \qquad (2)$$

where P = power produced by the turbine (W)
N = turbine wheel speed (rpm)
T = torque on turbine wheel (N•m)

Results:

The results can be presented as

1) A table of results including turbine speed, torque and power for two different flow rates.
2) Graphs of torque and power as a function of turbine speed at two different flow rates.